SMART CITY BASED ON IOT

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **"SMART CITY BASED ON IOT" is the bonafide work of Ms SELVA MEENA.M [Reg. No: 13BEC133], Ms SHARMILA.A.R [13BEC138] and Mr TAMIZHARASAN.N [13BEC156], Ms THARANI.A.D [13BEC157]** who carried out the project work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other project or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINAR **EXTERNAL EXAMINAR**

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ABSTRACT

The main aim of this project is to monitor the stuffs in the residential area such as street light, garbage and drainage system and also to display the current condition of those things in the website. Therefore, the corrective actions can be taken by the concerned authority. In this project, the street light can be operated from the website itself and the status of ON/OFF will also be displayed. This is possible because of the LDR sensors. And, this project also shows the percentage of waste filled in the garbage and drainage. Thus, the corrective measures can be taken without any delay. To identify these, ultrasonic sensors and float sensors are used. We are going to use Raspberry Pi for this project. And all these can be programmed in python language. These are connected over the internet with the help of "IOT" technology. This serves a very reliable and effective way to develop a "SMART CITY BASED ON IOT".

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ABBREVIATIONS

IoT	Internet of Things
HTML	Hyper Text Markup Language
PHP	Hypertext Preprocessor
RISC	Reduced Instruction Set Computer
CSS	Cascading Style Sheets
LCD	Liquid Crystal Display
ADC	Analog- Digital Converter
IP	Internet Protocol
LED	Light Emitting Diode
CPU	Central Processing Unit
ARM	Advanced risk machine
GPIO	General Purpose Input Output
GSM	Global System for mobile communication
LDR	Light Dependent Resistor
SPI	Serial Peripheral Interface
RISC	Reduced Instruction Set Computer
GPU	General Purpose Input
USB	Universal Serial Bus

CHAPTER – 1

INTRODUCTION

1.1 – BASICS OF IoT

The Internet of things (IoT) is the internetworking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items—embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In 2013 the Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society."

The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure. Experts estimate that the IoT will consist of almost 50 billion objects by 2020.

Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, and expanding to the areas such as smart cities.

"Things", in the IoT sense, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist firefighters in search and rescue operations. Legal scholars suggest to look at "Things" as an "inextricable mixture of hardware, software, data and service". These devices collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. Current market examples include home automation (also known as smart home devices) such as the control and automation of lighting, heating (like smart thermostat), ventilation, air conditioning (HVAC) systems, and appliances such as washer/dryers, robotic vacuums, air purifiers, ovens or refrigerators/freezers that use Wi-Fi for remote monitoring.

As well as the expansion of Internet-connected automation into a plethora of new application areas, IoT is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively. IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems.

The concept of the Internet of Things was invented by and term coined by Peter T. Lewis in September 1985 in a speech he delivered at a U.S. Federal Communications Commission (FCC) supported session at the Congressional Black Caucus 15th Legislative Weekend Conference. The Internet of Things (IoT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. So Internet of Things or IoT basically is connecting Embedded System to internet.

We can connect several input and output devices with these microcontrollers which are either memory mapped or IO mapped. These simple hardware includes LCD

display, buzzers, keypad (numpad) or even a printer. We connect several sensors through A/D interface. The devices can control Higher Power/Voltage/Current rating devices like fans, motors, bulbs using drives devices like relay-optocoupler and so on.

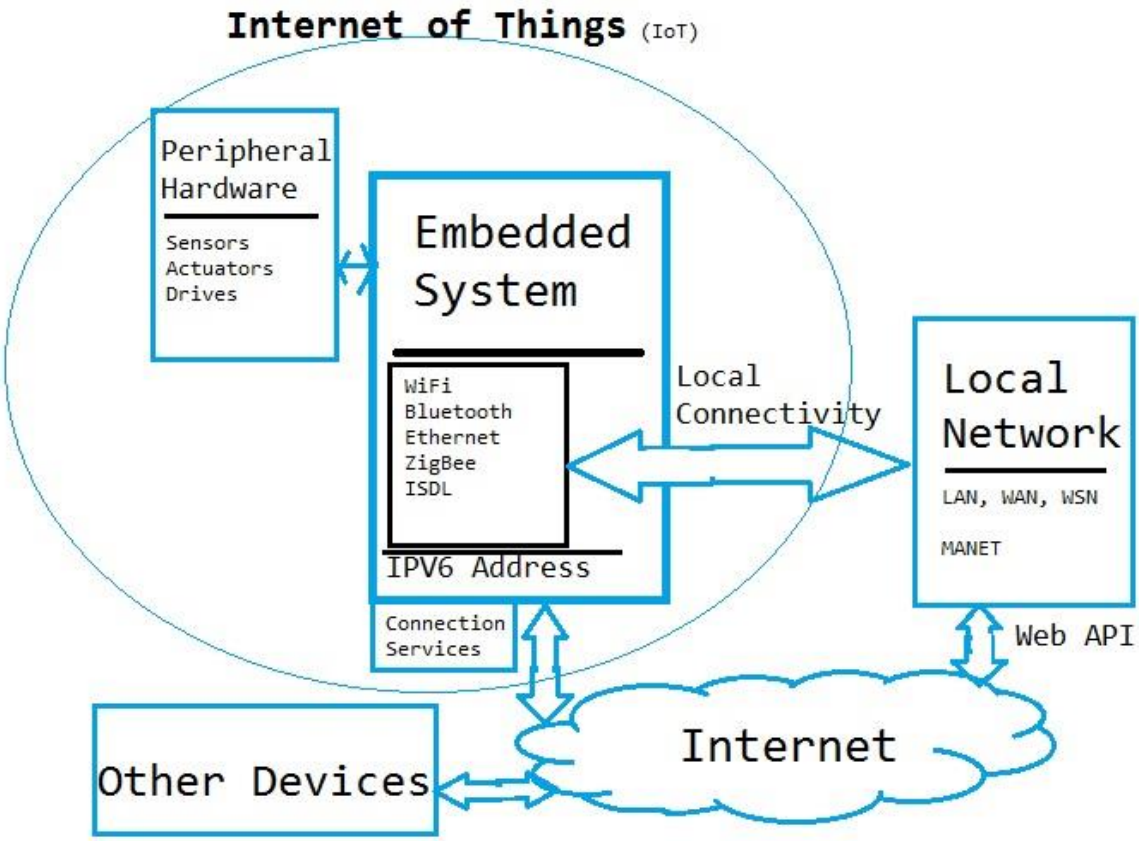

Fig. 1.2 Internet of Things (IoT) basic architecture

Most interestingly, these devices must be uniquely discovered. For unique discovery of the devices in a Network, they need to have unique IP address. As number of IoT devices online is expected to supress 20 billion mark and that IPv4 can only support up to 4 Billion unique addresses, IoT devices essentially have IPv6 addressing scheme. All these devices have either fixed or Subnet masked IP addresses of type v6. Unique IP addresses makes IoT devices discoverable in the internet as independent node. This is the most important concept to have in mind to understand IoT.

New Internet of Things (IoT) applications that leverage ubiquitous connectivity, big data and analytics are enabling Smart City initiatives all over the world. These new applications introduce tremendous new capabilities such as the ability to remotely monitor, manage and control devices, and to create new insights and actionable information from massive streams of real-time data. As a result, IoT offerings are transforming cities by improving infrastructure, creating more efficient and cost effective municipal services, enhancing public transportation, reducing traffic congestion, and keeping citizens safe and more engaged in the community.

1.3 – SMART CITY

In this project, we are going to implement the idea of IoT in our residential area in order to overcome the basic difficulties which we face in our day-to-day life. In this project, we are going to use Raspberry Pi, LDR, ultrasonic sensor, float sensor, LED and incorporate internet with this setup. We are going to switch on/off the street lights according to the environment and also display whether the lights are functioning properly or not. And also, we are going to display how much percentage does the garbage and drainage are filled up. All these are displayed in the corporation authority. So that the concerning actions will be taken immediately without any delay. All these are programmed using python language.

Street light are the major requirement in today's life of transportation for safety purposes and avoiding accidents during night. Despite that, in today's busy life, no one bothers to switch it off/on when not required. This project gives solution to minimise power consumption and manpower. Street light monitoring requires LDR, sensors and microcontroller. In this paper, we have designed an automatic street light control system using a simple light dependant resistor (LDR).

This project will help to eradicate or minimize the garbage disposal problem. The System will inform the status of each and every dust bin in real time so that the concerned authority can send the garbage collection vehicle only when the dustbin is full. For this purpose, ultrasonic sensor is used. It is used to indicate whether the garbage is filled or not. So, the garbage bin can be emptied immediately.

In this project drainage management system is mainly aimed at monitoring the flow of water in the drainage system. The float sensor is used, and it monitors the capacity of the drainage water and displays the percentage amount of the water filled in the website. So that, the blockage can be cleared immediately by the workers.

Thus, it helps to facilitate the functioning of basic things in the residential area with the help of real-time data which are displayed in the website, so that the current status of the stuffs can be viewed and, therefore, the measurements can be taken at the correct time.

CHAPTER – 2

HARDWARE DESCRIPTION

2.1 – DESIGN OF WORKING MODEL

The sensors such as ultrasonic sensor, float sensor, LDR sensor and power LED are interfaced with the raspberry pi 3. This is the basic outline block of the project. The inputs are given by the sensors to the raspberry pi and the program is written to process the inputs and the results are displayed in the website.

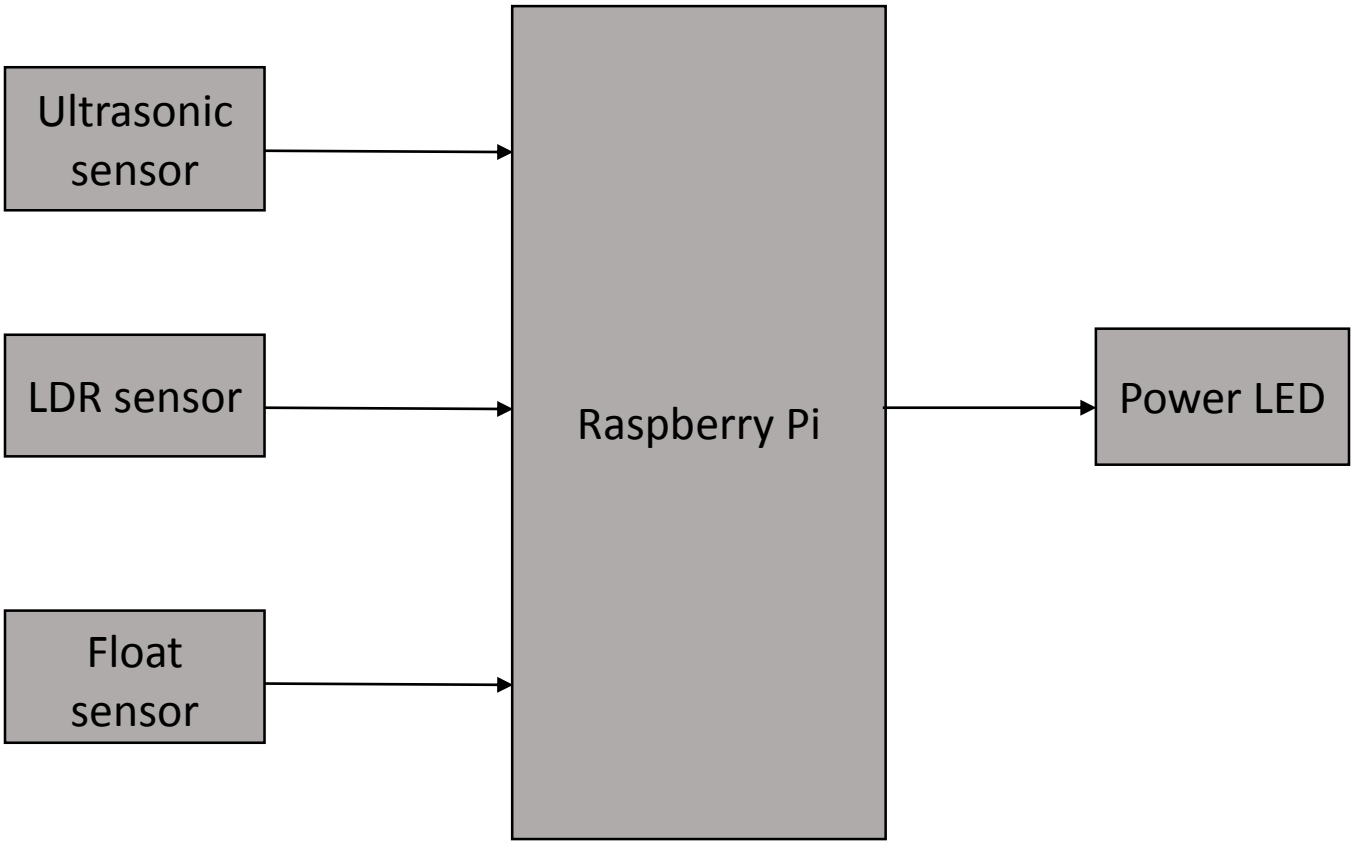

Fig. 2.1.1 Block diagram of the model

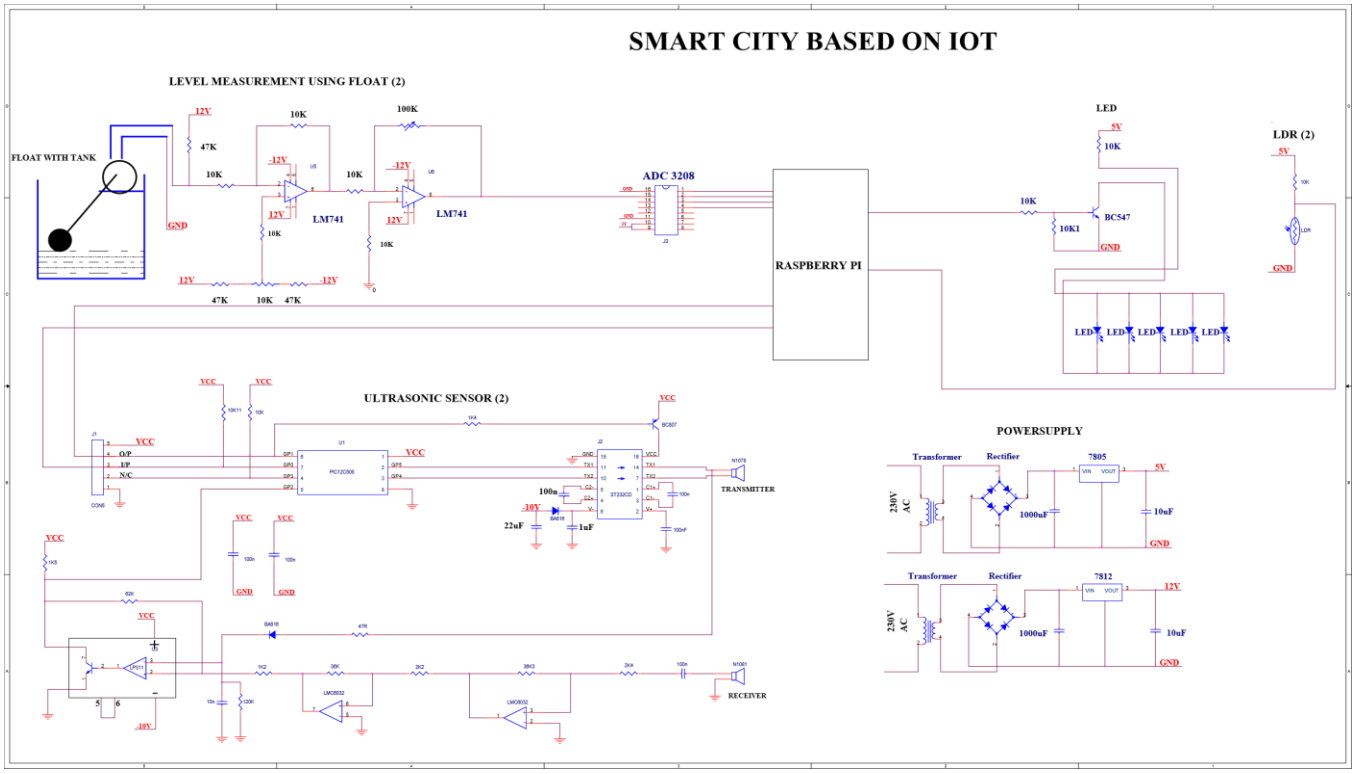

Fig. 2.1.2 Circuit diagram of the model

In the above circuit diagram, all the connections are clearly shown and the interfaces of sensors with the electronic components are also explained. The power supply unit connections are also presented above. We have used two ultrasonic sensors, two float sensors, two LDR sensors and four power LEDs, one ADC MCP3208, four voltage divider blocks and one raspberry pi 3 along with the power supply unit. For providing supply to the raspberry pi 3, an USB cable is required and to view the output in the website, an ethernet cable is needed.

2.2 - RASPBERRY PI 3

The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries.

Fig. 2.2.1 Raspberry Pi 3 board

Raspberry Pi 3 Model B released in February 2016 is bundled with on-board WiFi and Bluetooth. As of January 2017, Raspberry Pi 3 Model B is the newest mainline Raspberry Pi. The Raspberry Pi is a credit-card-sized computer that plugs into your TV and a keyboard. It is a capable little computer which can be used in electronics projects, and for many of the things that your desktop PC does, like spreadsheets, word processing, browsing the internet, and playing games. It also plays high-definition video. We want to see it being used by adults and children all over the world to learn programming and digital making. The Raspberry Pi measures 85.60mm *56mm*21mm (or roughly 3.37" *2.21" * 0.83"), with a little overlap for the SD card and connectors which project over the edges. It weighs 45g. RPi boards are priced between US$5–35.It promotes Python and Scratch as the main programming language, with support for many other languages. Any language which will compile for ARMv6 (Pi1) or ARMv7 (Pi2) can be used with Raspberry Pi, though, so you are not limited to using Python. C, C++, Java, Scratch, and Ruby all come installed by default on the Raspberry Pi. The Broadcom BCM2835 SoC used in the first generation Raspberry Pi is somewhat equivalent to the chip used in first generation smartphones (its CPU is an older ARMv6 architecture). It has a level 1 (L1) cache of 16 KB and a level 2 (L2) cache of 128 KB. The level 2 cache is used

primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible. The Raspberry Pi 3 is equipped with 2.4 GHz WiFi 802.11n (150 Mbit/s) and Bluetooth 4.1 (24 Mbit/s) in addition to the 10/100 Ethernet port. The Raspberry Pi does not have a built-in real-time clock, and does not "know" the time of day. As a workaround, a program running on the Raspberry Pi can get the time from a network time server or user input at boot time, thus knowing the time while powered on. A real-time hardware clock with battery backup, such as the DS1307, which is fully binary coded, may be added. The Raspberry Pi primarily uses Raspbian, a Debian-based Linux operating system. Other third party operating systems available via the official website include Ubuntu MATE, Snappy Ubuntu Core, Windows 10 IoT Core, RISC OS and specialised distributions for the Kodi media center and classroom management. Many other operating systems can also run on the Raspberry Pi.

Product	Recommended PSU current capacity	Maximum total USB peripheral current draw	Typical bare-board active current consumption
Raspberry Pi Model A	700mA	500mA	200mA
Raspberry Pi Model B	1.2A	500mA	500mA
Raspberry Pi Model A+	700mA	500mA	180mA
Raspberry Pi Model B+	1.8A	600mA/1.2A (switchable)	330mA
Raspberry Pi 2 Model B	1.8A	600mA/1.2A (switchable)	
Raspberry Pi 3 Model B	2.5A	1.2A	~400mA

Table 2.2.2 Various Raspberry Pi models

2.2.3 - Raspberry Pi 3 specifications

- Chipset: Broadcom BCM2837
- CPU: 1.2GHz quad-core 64-bit ARM cortex A53
- Ethernet : 10/100 (Max throughput 100Mbps)
- USB: Four USB 2.0 with 480Mbps data transfer
- Storage: MicroSD card or via USB-attached storage
- Wireless: 802.11n Wireless LAN

  (Peak transmit/receive throughput of 150Mbps), Bluetooth 4.1
- Graphics: 400MHz VideoCore IV multimedia
- Memory: 1GB LPDDR2-900 SDRAM
- Expandability: 40 general purpose input-output pins
- Video: Full HDMI port
- Audio: Combined 3.5mm audio out jack and composite video
- Camera interface (CSI)
- Display interface (DSI)

BCM2835 contains the following peripherals which may safely be accessed by the ARM are timers, interrupt controller, GPIO, USB, PCM / I2S, DMA controller, I2C master, I2C / SPI slave, SPI0, SPI1, SPI2, PWM, UART0, UART1.

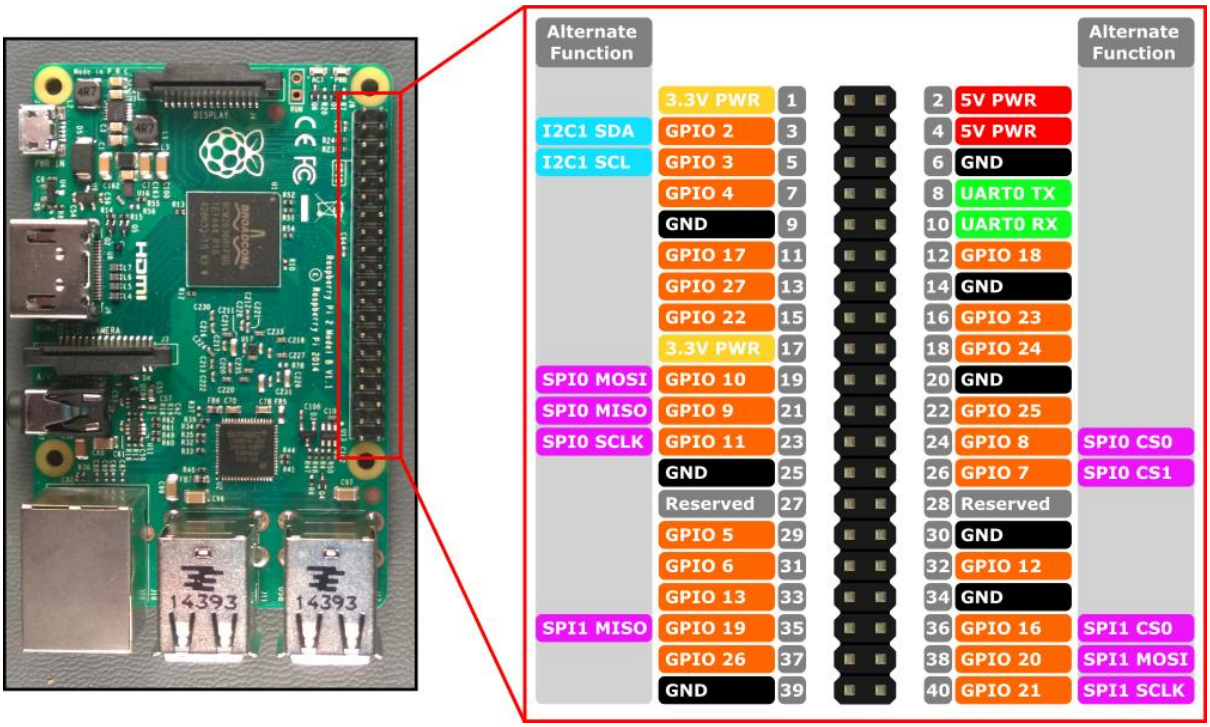

Fig. 2.2.4 Raspberry Pi 3 GPIO pins

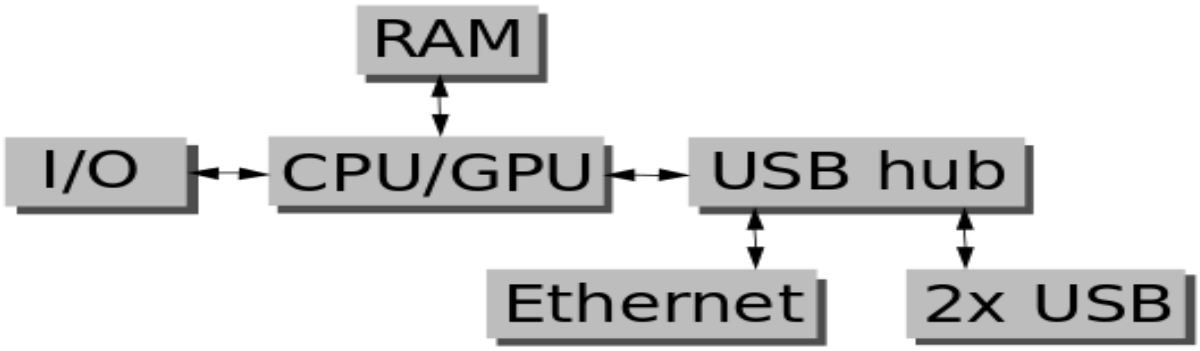

Fig. 2.2.5 Raspberry Pi 3 block diagram

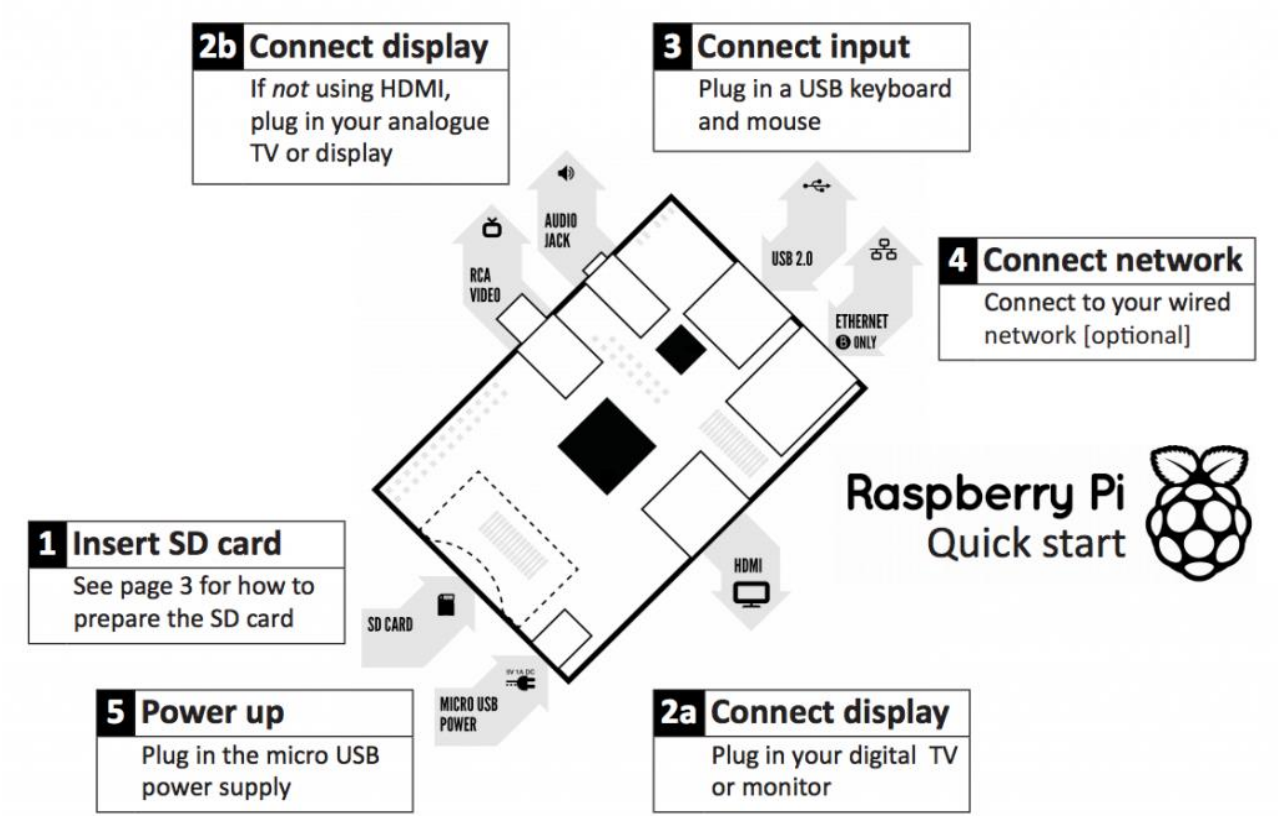

Fig. 2.2.6 Raspberry Pi 3 sockets

2.3 - LDR SENSOR

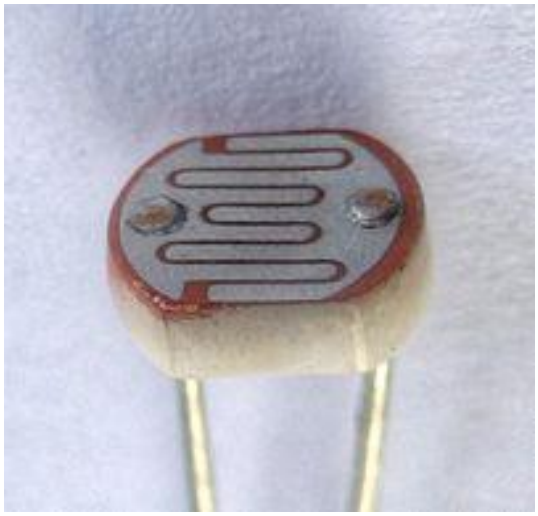

Fig. 2.3.1 LDR sensor

A photoresistor or LIGHT DEPENDENT RESISTOR or cadmium sulfide (CdS) cell is a resistor whose resistance decreases with increasing incident light intensity. It can also be referred to as a photoconductor.

A photoresistor is made of a high resistance semiconductor. If light falling on the device is of high enough frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electron (and its hole partner) conduct electricity, thereby lowering resistance.

A photoelectric device can be either intrinsic or extrinsic. An intrinsic semiconductor has its own charge carriers and is not an efficient semiconductor, e.g. silicon. In intrinsic devices the only available electrons are in the valence band, and hence the photon must have enough energy to excite the electron across the entire bandgap.

Extrinsic devices have impurities, also called dopants, added whose ground state energy is closer to the conduction band; since the electrons do not have as far to jump, lower energy photons (i.e., longer wavelengths and lower frequencies) are sufficient to trigger the device.

If a sample of silicon has some of its atoms replaced by phosphorus atoms (impurities), there will be extra electrons available for conduction. This is an example of an extrinsic semiconductor.

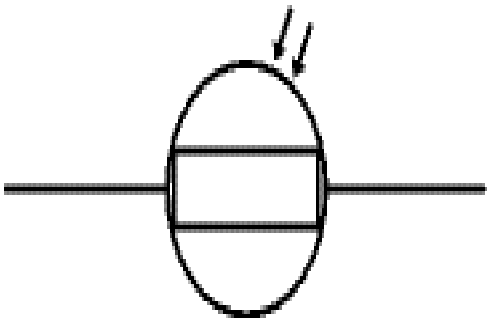

Fig. 2.3.2 LDR symbol

This is a resistor whose resistance depends on the amount of light falling on it. This is the circuit symbol for a diode. The arrows represent light falling on the LDR. When light falls on an LDR its resistance falls rapidly. In low light or the dark – they act as high resistors. In bright light they offer very little resistance.

2.4 - LED

Fig. 2.4.1 LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. When a light-emitting diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the colour of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm^2), and integrated optical components are used to shape its radiation pattern and assist in

reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. LEDs powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output.

2.5 - FLOAT SENSOR

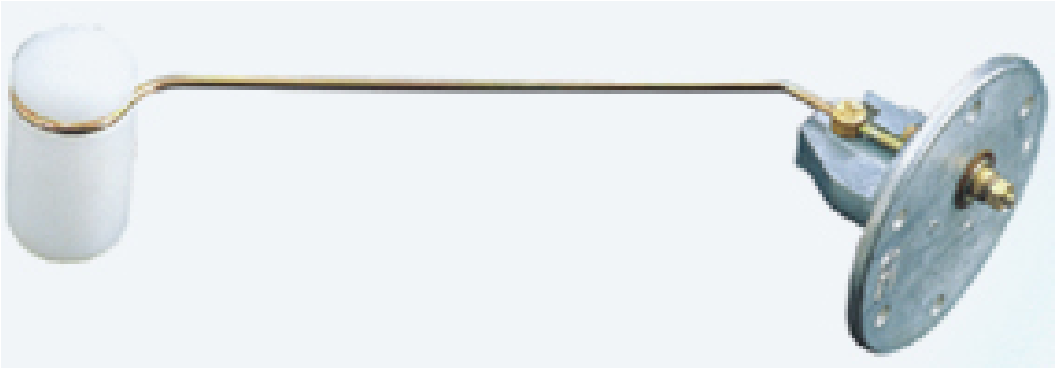

Fig. 2.5.1 Float sensor

Float sensors detect the level of substances that flow, including liquids, slurries, granular materials, and powders. All such substances flow to become essentially level in their containers (or other physical boundaries) because of gravity. The substance to be measured can be inside a container or can be in its natural form (e.g. a river or a lake). The level measurement can be either continuous or point values. Continuous float sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-float sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low. A float switch is a device used to detect the level of liquid within a tank. The switch may be used in a pump, an indicator, an alarm, or other devices. Float switches range from small to large and may be as simple as a mercury

switch inside a hinged float or as complex as a series of optical or conductance sensors producing discrete outputs as the liquid reaches many different levels within the tank. Perhaps the most common type of float switch is simply a float raising a rod that actuates a micro switch. A very common application is in sump pumps and condensate pumps where the switch detects the rising level of liquid in the sump or tank and energizes an electrical pump which then pumps liquid out until the level of the liquid has been substantially reduced, at which point the pump is switched off again. Float switches are often adjustable and can include substantial hysteresis. That is, the switch's "turn on" point may be much higher than the "shut off" point. This minimizes the on-off cycling of the associated pump. Some float switches contain a two-stage switch. As liquid rises to the trigger point of the first stage, the associated pump is activated. If the liquid continues to rise (perhaps because the pump has failed or its discharge is blocked), the second stage will be triggered. This stage may switch off the source of the liquid being pumped, trigger an alarm, or both.

It normally consists of:

a) Float (NBR type/PU type) with level arm

b) Potentiometer

As the liquid is consumed or emptied in tank the float moves up/down and it increases or decreases the resistance of potentiometer which includes TFR type to indicate the liquid level in the tank.

2.5.2 - Features of float sensor

- Thick film resister/ wire wound resister
- Heavy duty die cast design/ sheet metal (Aluminium) design.
- Spring steel Lever

2.6 - ULTRASONIC SENSOR

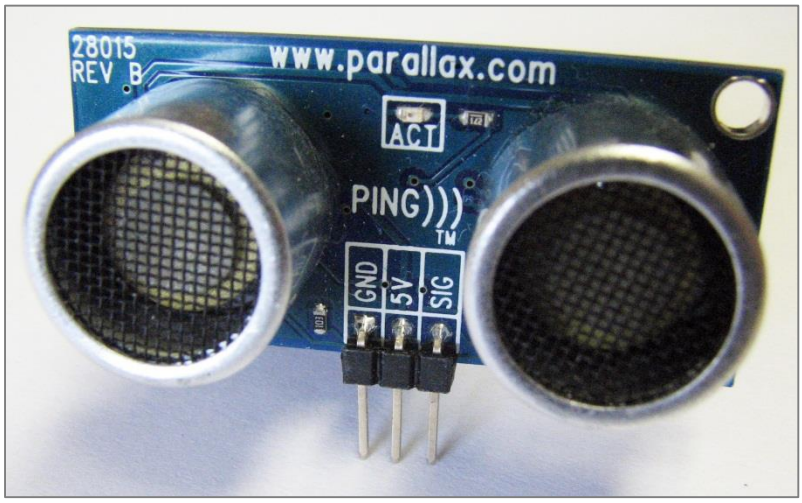

Fig. 2.6.1 Ultrasonic sensor front view

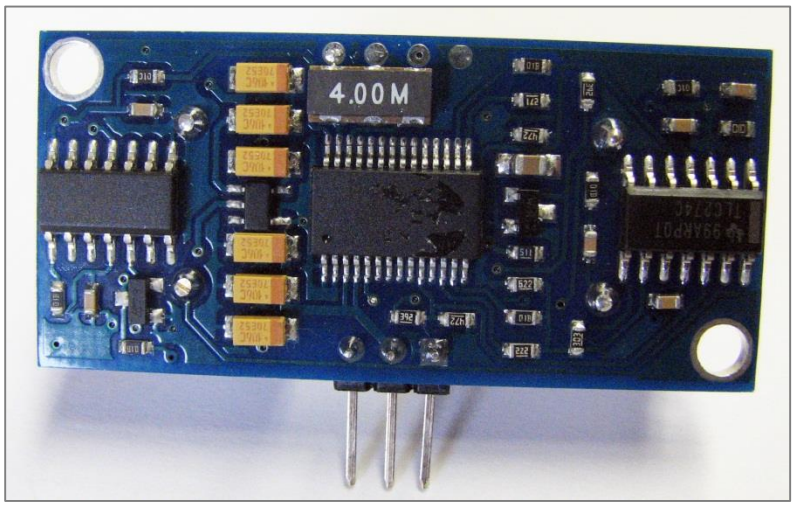

Fig. 2.6.2 Ultrasonic sensor rear view

Ultrasonic sensors (also known as transceivers when they both send and receive) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. This technology can be used

for measuring: wind speed and direction (anemometer), fullness of a tank and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure the amount of liquid in a tank, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing. Systems typically use a transducer which generates sound waves in the ultrasonic range, above 20,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed. The technology is limited by the shapes of surfaces and the density or consistency of the material. For example foam on the surface of a fluid in a tank could distort a reading.

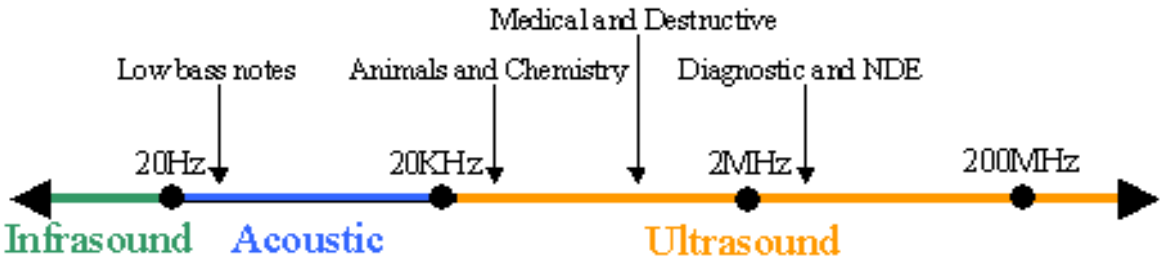

Fig. 2.6.3 Ultrasonic frequency range

Ultrasonic refers to any study or application of sound waves that are higher frequency than the human audible range. Music and common sounds that we consider pleasant are typically 12 kHz or less, while some humans can hear frequencies up to 20 kHz. Ultrasonic waves consist of frequencies greater than 20 kHz and exist in excess of 25 MHz. Ultrasonic waves are used in many applications including plastic welding, medicine, jewellery cleaning, and non-destructive test. Within non-destructive test, ultrasonic waves give us the ability to “see through” solid/opaque material and detect surface or internal flaws without affecting the material.

2.6.4 – Basics of ultrasonic test

Ultrasonic wavelengths are on the same order of magnitude as visible light, giving them many of the same properties of light. For example, ultrasonic wavelengths can be focused, reflected, and refracted. Ultrasonic waves are transmitted by high frequency particle vibrations, and can be transmitted through air, water, and solids such as steel. These waves are transmitted in homogenous solid objects much like pointing a flashlight around a room with various objects that reflect light. The directed energy in an ultrasonic wave is reflected by boundaries between materials regardless of whether the material is gas, liquid, or solid. Ultrasonic waves are also reflected by any cracks or voids in solid materials. These reflected waves, which are caused by internal defects, can be compared to the reflected waves from the external surfaces, enabling the size and severity of intern defects to be identified.

Generating and detecting ultrasonic waves requires an ultrasonic transducer. Piezoelectric ceramics within ultrasonic transducers are "struck" – similar to the way tuning forks are struck to generate an audible note - with electricity, typically between 50 and 1000 Volts - to produce the ultrasonic wave. The ultrasonic wave is carried from the transducer to the unit under test (UUT) by a coolant - typically water, oil, or gel - and is reflected back to the transducer by both external surfaces and internal defects.

When operating in pulse-echo mode, ultrasonic transducers act as both emitters and receivers. The reflected ultrasonic waves vibrate the piezoelectric crystal within the ultrasonic transducer and generate voltages that are measurable by data acquisition hardware. When operating in through-transmission mode, two ultrasonic transducers are used; one transducer generates the wave and the other receives the wave.

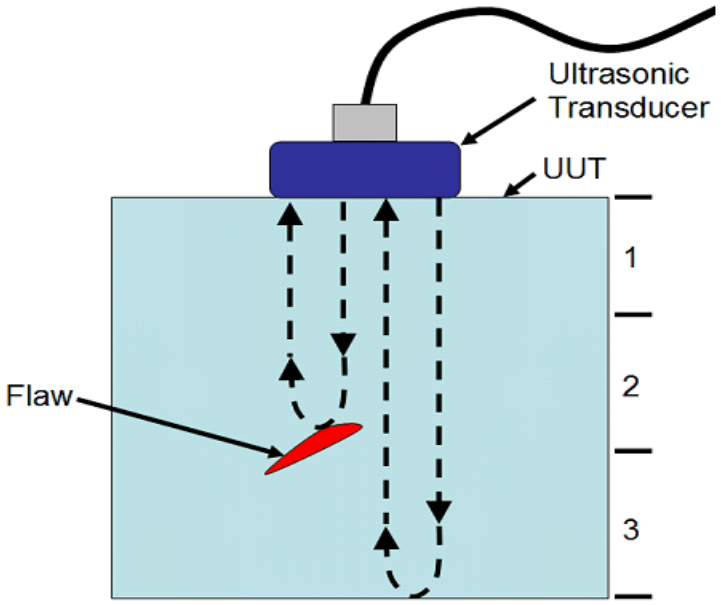

Fig. 2.6.5 Travelling of ultrasonic waves

In a typical application, the ultrasonic transducer is struck with a high voltage pulse, which lasts on the order of 5 microseconds, then the system listens for the echoes. The system listens on the order of 10-15 milliseconds. Even in the most advanced systems, the transducers are pulsed every 500 microseconds.

The most primitive method to analyze the reflected ultrasonic signals is time-of-flight (TOF) display, or A-Scan. Discontinuities that are closer to the ultrasonic transducer are received sooner than those further away from the transducer.

Most ultrasonic non-destructive test applications range from 400 kHz to 25 MHz. The frequency of the ultrasonic sensor is chosen based on several factors including detectable flaw size, depth of penetration, and grain size of the material. Materials made up of fine grained material, such as metals, permit deep penetration by ultrasonic waves of all frequencies. However, coarse-grained material, including many plastics, scatter high frequency ultrasonic waves. The higher the frequency, the smaller flaws the system will detect, but the depth of penetration decreases.

A common use of ultrasound is in range finding; this use is also called SONAR, (sound navigation and ranging). This works similarly to RADAR (radio detection and ranging): An ultrasonic pulse is generated in a particular direction. If there is an object in the path of this pulse, part or all of the pulse will be reflected back to the transmitter as an echo and can be detected through the receiver path. By measuring the difference in time between the pulse being transmitted and the echo being received, it is possible to determine how far away the object is.

The measured travel time of SONAR pulses in water is strongly dependent on the temperature and the salinity of the water. Ultrasonic ranging is also applied for measurement in air and for short distances. Such method is capable for easily and rapidly measuring the layout of rooms.

Although range finding underwater is performed at both sub-audible and audible frequencies for great distances (1 to several ten kilo meters), ultrasonic range finding is used when distances are shorter and the accuracy of the distance measurement is desired to be finer. Ultrasonic measurements may be limited through barrier layers with large salinity, temperature or vortex differentials. Ranging in water varies from about hundreds to thousands of meters, but can be performed with centimeters to meters accuracy.

Ultrasound when applied in specific configurations can produce short bursts of light in exotic phenomena known as sono-luminescence. This phenomena is being investigated partly because of the possibility of bubble fusion (a nuclear fusion reaction hypothesized to occur during sono-luminescence).

Recently researchers at the University of Alberta in Canada have successfully used ultrasound to regenerate dental material. Ultrasound is used when characterizing particulates through the technique of ultrasound attenuation spectroscopy or by

observing electro acoustic phenomena. In rheology, an acoustic rheometer relies on the principle of ultrasound. In fluid mechanics, fluid flow can be measured using an ultrasound flow meter. Ultrasound also plays a role in Sonic weaponry.

2.7 - ADC MCP3208

ADC (Analog to Digital Converter) is an electronic device that converts a continuous analog input signal (Real world signals that contain noise which is Continuous in time) to discrete digital numbers (Discrete in time and value and binary 0 or 1)

- All microcontrollers store information using digital logic.
- Compress information to digital form for efficient storage.
- Medium for storing digital data is more robust.
- Digital data transfer is more efficient.
- Digital data is easily reproducible.
- Provides a link between real-world signals and data storage.

2.7.1 – Features of ADC

- 12 bit resolution and SPI serial interface.
- Low power CMOS technology:

  -500nA typical standby current, 2µAmax.

  - 400 µA max. active current at 5V
- Industrial temp range: -40°C to +85°C

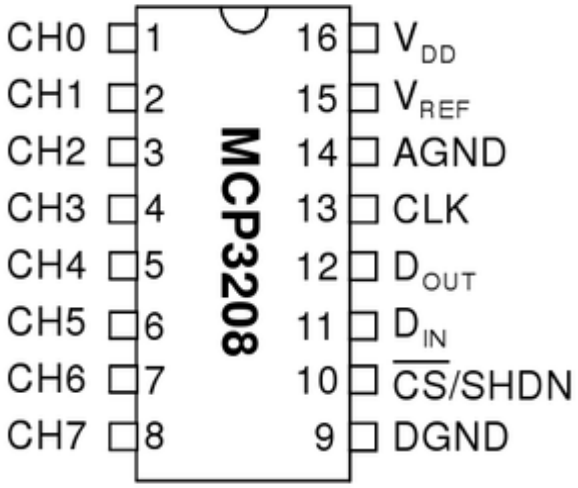

Fig. 2.7.2 Pin diagram of MCP3208

2.8 - VOLTAGE DIVIDER CIRCUIT

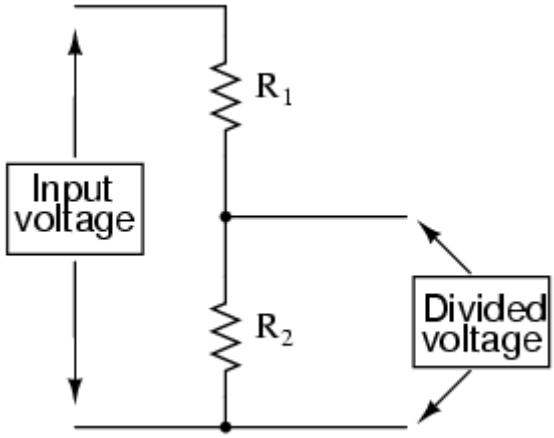

Fig. 2.8.1 Circuit diagram of voltage divider block

A voltage divider (also known as a potential divider) is a passive linear circuit that produces an output voltage (V_{out}) that is a fraction of its input voltage (V_{in}). Voltage division is the result of distributing the input voltage among the components of the divider. A simple example of a voltage divider is

two resistors connected in series, with the input voltage applied across the resistor pair and the output voltage emerging from the connection between them.

Resistor voltage dividers are commonly used to create reference voltages, or to reduce the magnitude of a voltage so it can be measured, and may also be used as signal attenuators at low frequencies. For direct current and relatively low frequencies, a voltage divider may be sufficiently accurate if made only of resistors; where frequency response over a wide range is required (such as in an oscilloscope probe), a voltage divider may have capacitive elements added to compensate load capacitance. In electric power transmission, a capacitive voltage divider is used for measurement of high voltage.

Voltage dividers can be used to allow a microcontroller to measure the resistance of a sensor. The sensor is wired in series with a known resistance to form a voltage divider and a known voltage is applied across the divider. The microcontroller's analog-to-digital converter is connected to the center tap of the divider so that it can measure the tap voltage and, by using the measured voltage and the known resistance and voltage, compute the sensor resistance. An example that is commonly used involves a potentiometer (variable resistor) as one of the resistive elements. When the shaft of the potentiometer is rotated the resistance it produces either increases or decreases, the change in resistance corresponds to the angular change of the shaft. If coupled with a stable voltage reference, the output voltage can be fed into an analog-to-digital converter and a display can show the angle. Such circuits are commonly used in reading control knobs. Note that the potentiometer must have a linear taper.

2.9 - POWER SUPPLY

Fig. 2.9.1 Step down transformer

The power supply of 230V is step down by a transformer and then regulator is used to regulate 5V to the components.

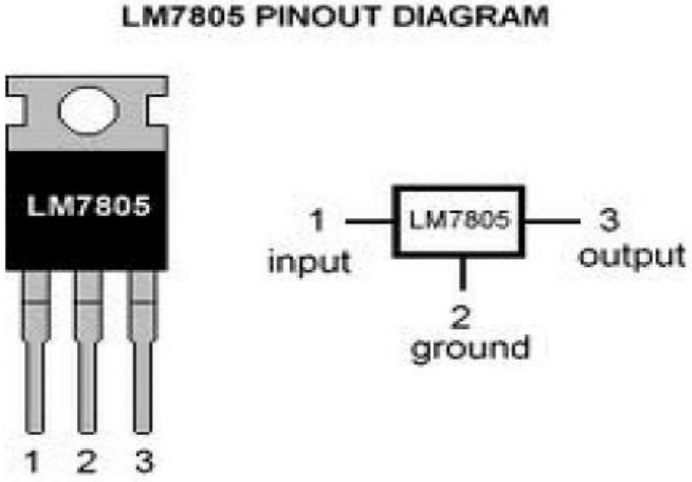

Fig. 2.9.2 LM7805 Regulator

CHAPTER – 3

SOFTWARE DESCRIPTION

3.1 - RASPBIAN JESSIE OS

The Raspbian operating system is based on Debian Linux, and the different versions of Debian are named after characters from the "Toy Story" films. Recent versions of Raspbian have been based on Debian Wheezy (the penguin who's lost his squeaker in "Toy Story 2"), but Raspbian has now been updated to the new stable version of Debian, which is called Jessie.

Many of the changes between Wheezy and Jessie are invisible to the end-user. There are modifications to the underlying system to improve performance and flexibility, particularly as regards the control of system processes, and as with any update, there are numerous bug fixes and tweaks. And at the same time as the upgrade to Jessie, there have been added a bunch of changes and improvements to the desktop user interface.

3.1.1 – Installation of OS

Before installing the OS, we (obviously) should have a micro SD card and a computer with an SD card reader. Besides that, download the Raspbian image file directly from raspberry.com

Insert the micro SD card into the card reader and find out its drive letter in Windows Explorer (for example G:)

- Download Win32DiskImager, unzip the downloaded file and run the utility file.

- Select the Raspbian image file we downloaded.

- Select the drive of the SD card in the ‘Device’ dropdown. Make sure we chose the correct one. Otherwise, we risk damaging the data on our hard drive.

- Select ‘Write’ and wait for the process to finish.
- Now we can plug the SD card into our Raspberry Pi’s slot.

3.1.2 – Setting up WiFi

To set up WiFi:

Put the SD card with the installed operating system in our computer’s card reader. Open up the terminal and enter the following line:

sudo nano /path/to/sd/card/etc/network/interfaces

Make sure to type in the correct path to your SD card. An example could look like the following:

sudo nano /Volumes/sd-card-name/etc/network/interfaces

This command opens up the interfaces file inside the terminal using the nano text editor. Now we have to type the network name and the password.

Save the file by pressing “CTRL + X”, hitting “y” and pressing enter. Now we can put the microSD card into the Raspberry Pi’s card slot.

Make sure the microSD card is plugged into the RPi. Now either plug in a USB WiFi adapter or an ethernet cable connected to the router.

In your terminal window, enter the following:

ssh pi@RPiIPaddress (example: ssh pi@192.168.1.32)

Replace ‘RPiIPaddress’ with our Raspberry Pi’s IP address. We can easily find its IP address in our router’s browser interface, for example, the default password is “raspberry”.

Now we need to create a folder on our Raspberry Pi that will be connected with the TV Shows folder on our NAS. Create this folder with the following line

sudo mkdir /home/pi/TVShows

Open the fstab file in the nano text editor by typing the following

sudo nano /etc/fstab

Copy and paste the following line at the bottom

192.168.0.50:/nfs/TVShows/home/pi/TVShowsnfsnouser,atime,auto,rw, dev,exec,suid00

Make sure to use the correct IP address of your NAS and to correct the folder locations and/or name if we chose something different. If you want to add a second folder (e.g. /nfs/Movies) then simply add the same line under the first and replace the folder name. Save the file with CTRL+X, then ‘Y’ and ‘Enter’.

3.2 - puTTY

A terminal emulator is an application that allows us to emulate the server’s terminal through our current PC (this is of integral importance for us to be able to communicate with the server).

Here are the most popular terminal emulators for the according OS:

- Mac OS X - Terminal, iTerm 2
- Windows - PuTTY

- Linux - Terminal, KDE Konsole, XTerm

Putty is a very useful application that can be used to connect to serial ports and Secure Shell (SSH) to Raspberry Pi's. Putty is mostly used on Windows to connect to remote devices but it can also run on a Raspberry Pi.

The first step that we will have to actually do is download the needed installation packages. That can be done by accessing the manufacturer's website, and going to the download section:

http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html

From there we could either download the installer for PuTTY, or just the PuTTY.exe. The difference between the two is that the PuTTY.exe is ready to run, and does not require any installation, but doesn't contain the other binaries that are listed.

After the download finishes run the PuTTY installer. The installer itself is quite straight forward, first it will ask you where the install directory should be.

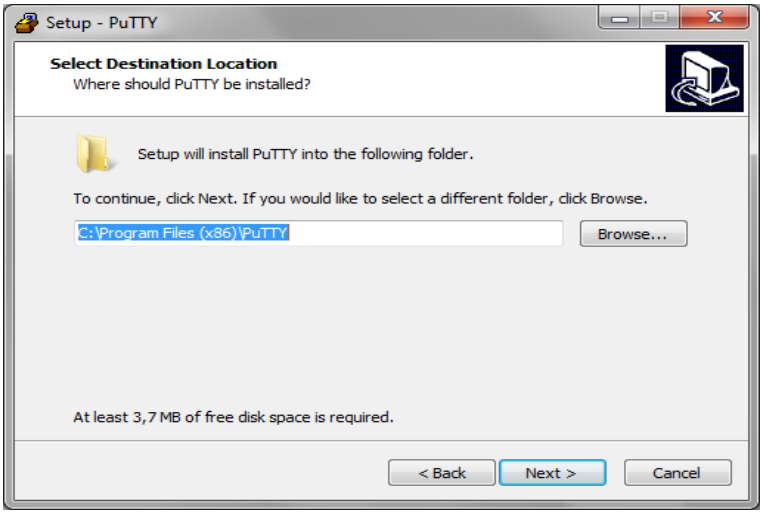

Fig. 3.2.1 Installing directory

Chose whichever directory is needed for the installation. Then choose the folder that will appear in the start menu and will store all the shortcuts.

The last part of the pre-installation configurations will ask what other additional icons should be created. For ease of use we will select **Create a desktop icon for PuTTY**. After that we should click **next** and proceed with the installation.

Firstly open the **PuTTY.exe** shortcut that has been created on our desktop.

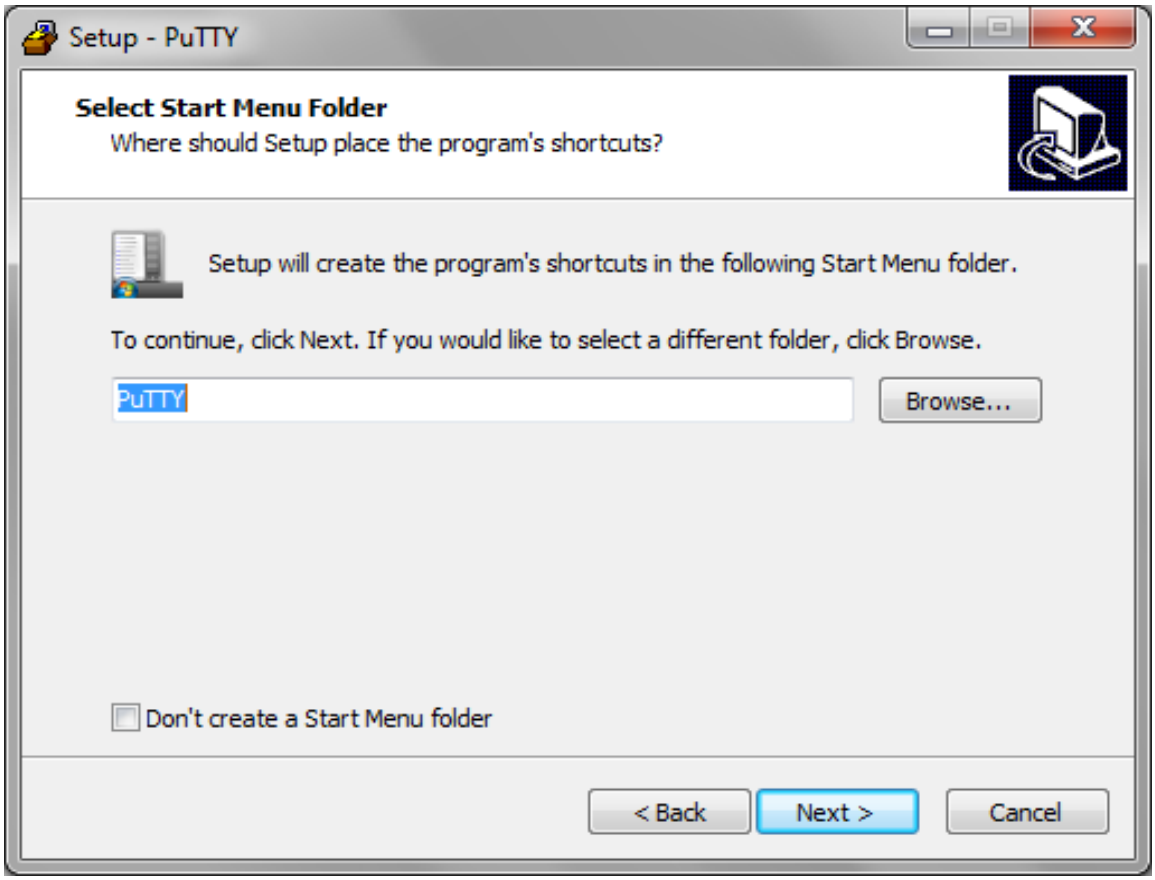

Fig. 3.2.2 Creating shortcut

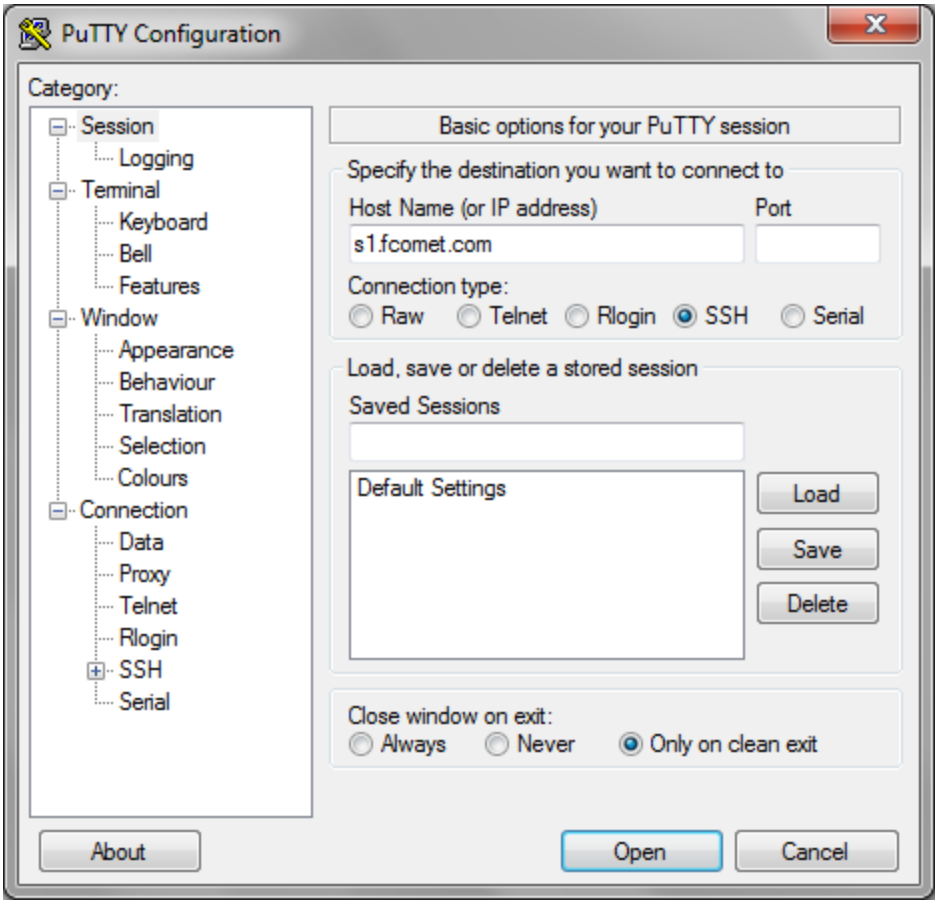

Fig. 3.2.3 opening puTTY

Make sure that we are on the **Session** tab**.** If the connection type is correct, proceed with entering the hostname and port. The hostname in this case is our s1.fcomet.com, or the VPS/DPS address that we have provided with (e.g.vm752.fcomet.com or ds535.fcomet.com). The other variant is to use the host server's IP address. As to the port, the default value is 22. Now after we've entered the connection details. We can click on **Open** in the lower right-hand corner. Since we are connecting to our web server for the very first time it is very likely that we will get prompted with the following error message:

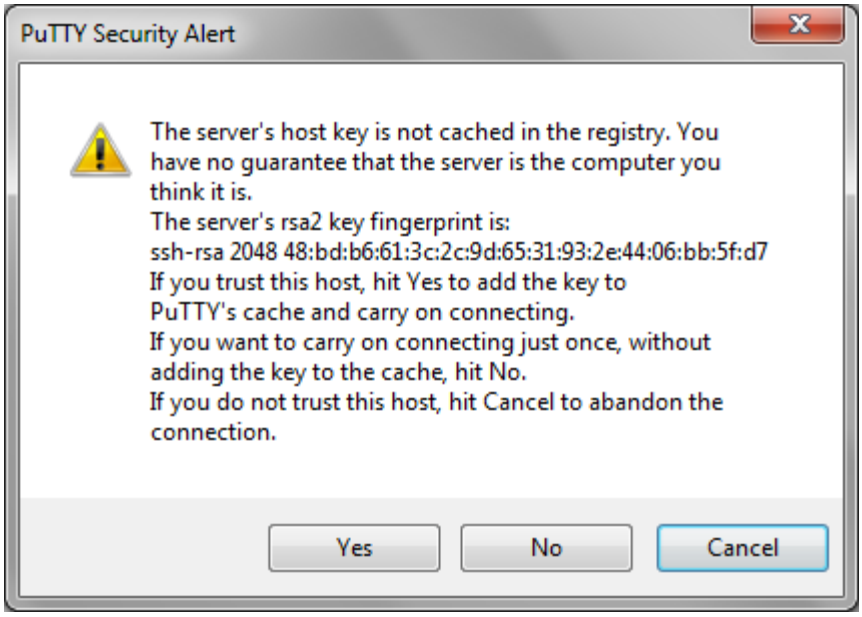

Fig. 3.2.4 Security alert

Just click **Yes** and advance to the next step. Now a black terminal window will open, which will prompt for username (this is the username that we use to login to our c Panel). In this case we are using example as a username.

Fig. 3.2.5 Entering username

Once we input the username and hit "**Enter**" we will be requested to enter the user password (again the password that we use to access our c Panel).

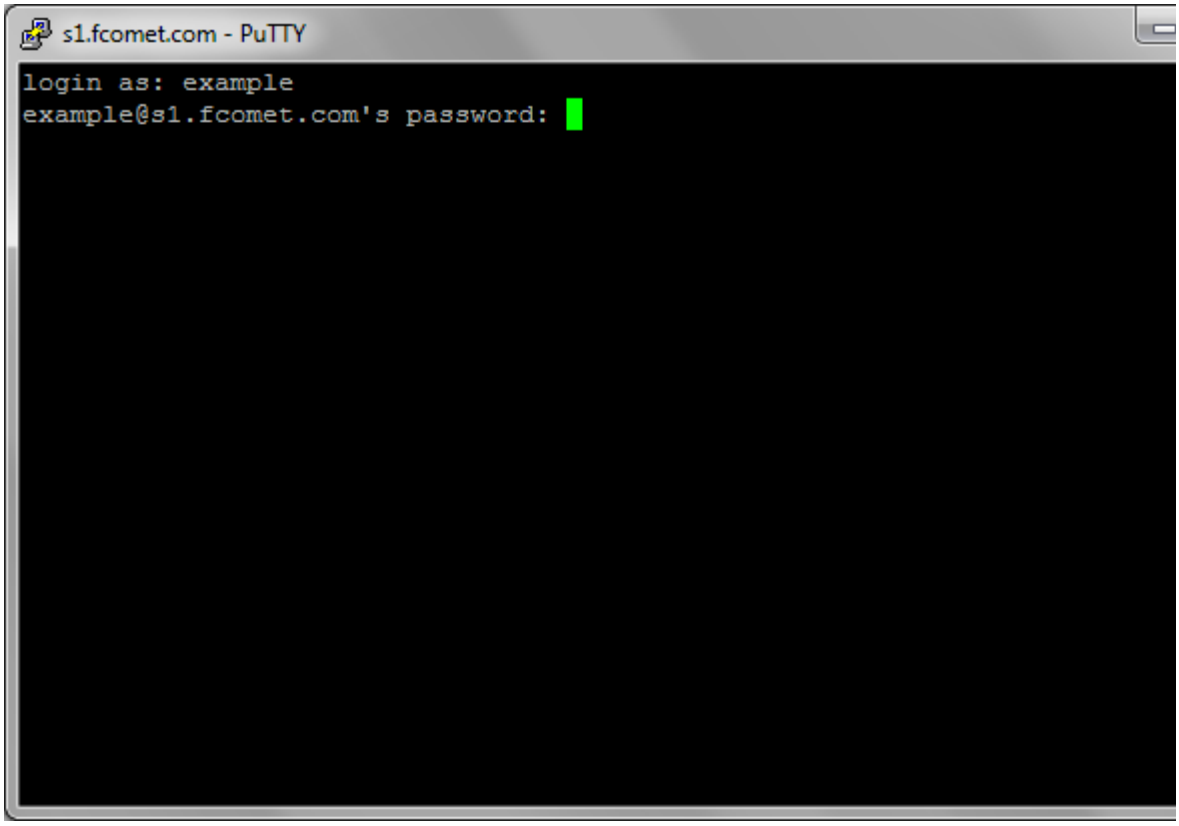

Fig. 3.2.6 Entering password

If all information is correct the shell prompt will appear

example@s2 [~]#

We can execute a command without arguments or parameters by simply typing in the name of the command that we want to be executed and hit 'ENTER'. The nature of the output of this method varies from command to command but for the basic commands such as:

- cd (used to navigate you around directories) it will just move you to the current user's home directory.

- ls (used to list the folders in the current directory).
- nano (used to view the files).
- python (used to run the program files with extension .py)

3.3 - **WinSCP**

To avoid having to use a USB stick to transfer files from our windows machine to our Raspberry Pi use WinSCP. When it opens setup the following:

Session

File Protocol : SCP
Host name : The IP address of your Raspberry Pi
User name : pi
Password : raspberry

Thus, we can transfer the files from the system to raspberry pi or vice versa.

3.4 - PYTHON LANGUAGE

By default, supporting Python as the educational language. Any language which will compile for ARMv6 can be used with the Raspberry Pi. High level programming language. It can be installed by the following command:

apt-get install python2.7

Mainly developed for emphasis on code readability. Syntax allows to express concepts in fewer lines of code. File extension – ".py". Variables used in python are case sensitive. Arithmetic operations in python can be performed by using arithmetic operators. Conditional output can be obtained by using if-else and elif (else if) statements. Iterations or looping can be performed in python by 'for' loops and

‘while’ loops. Function is declared using keyword ‘def’. Return type of function need not be specified explicitly in python.Python has a large standard library, commonly cited as one of Python's greatest strengths, providing tools suited to many tasks. This is deliberate and has been described as a “batteries included” Python philosophy. For Internet-facing applications, many standard formats and protocols (such as MIME and HTTP) are supported. Modules for creating graphical user interfaces, connecting to relational databases, generating pseudorandom numbers, arithmetic with arbitrary precision decimals, manipulating regular expressions, and doing unit testing are also included. Some parts of the standard library are covered by specifications (for example, the Web Server Gateway Interface (WSGI) implementation wsgiref follows PEP 333), but most modules are not. They are specified by their code, internal documentation, and test suites (if supplied). However, because most of the standard library is cross-platform Python code, only a few modules need altering or rewriting for variant implementations. As of November, 2016, the Python Package Index, the official repository containing third-party software for Python, contains over 92,000 packages offering a wide range of functionality, including:

- Graphical user interfaces, web frameworks, multimedia, databases, networking and communications
- Test frameworks, automation and web scraping, documentation tools, system administration
- Scientific computing, text processing, image processing

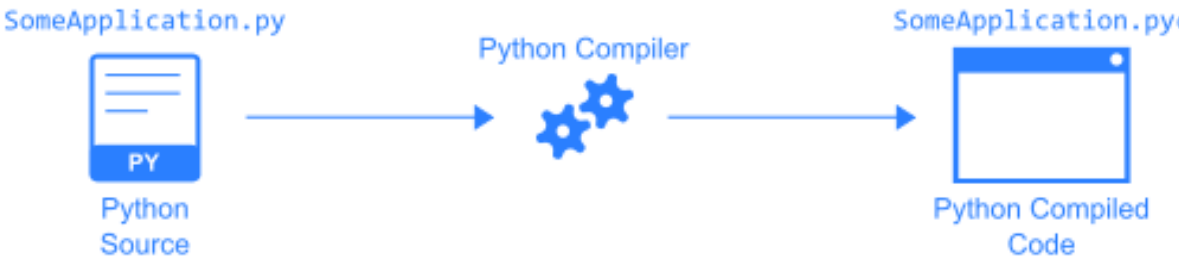

Fig. 3.4.1 Python code conversion

Most Python implementations (including C, Python) include a read–eval–print loop (REPL), meaning they can function as a command line interpreter, for which the user enters statements sequentially and receives the results immediately. Other shells add abilities beyond those in the basic interpreter, including IDLE and IPython. While generally following the visual style of the Python shell, they implement features like auto-completion, session state retention, and syntax highlighting. In addition to standard desktop integrated development environments (Python IDEs), there are also web browser-based IDEs, SageMath (intended for developing science and math-related Python programs), and a browser-based IDE and hosting environment, Python, anywhere. Additionally, the Canopy IDE is also an option for writing Python programs.

3.4.2 - Features of python

- Simple
- Easy to Learn
- Free and Open Source
- High-level Language
- Portable

- Interpreted
- Object Oriented
- Extensible
- Embeddable
- Extensive Libraries

3.5 - WEB SERVER

The Apache HTTP Server is the world's most used web server software. Most commonly used on a Unix-like system (usually Linux).Apache can serve HTML files over HTTP. It can serve dynamic web pages using scripting languages such as PHP. Apache web server can be installed on the Raspberry Pi to allow it to serve web pages by the following command:

root@raspberrypi ~ # sudo apt-get install apache2

By default, Apache puts a test HTML file in the web folder. This default web page is served when browsed the Pi itself, (Pi's IP address) from another computer on same network. Raspberry Pi's GPIO can be controlled from webpage using Wiring Pi. Executing applications with a PHP code can be done with two different functions:

- exec (for execute) and
- system

The system function takes two arguments, they are system (string $command, int $return_var). First parameter is the command to execute and Second one is the returned status of the executed command and isn't compulsory.

3.6 - FILE SHARING SERVER

Samba is re-implementation of the SMB/CIFS networking protocol. Server Message Block (SMB) or Common Internet File System (CIFS) mainly used for providing shared access to files, printers and serial ports between nodes on a network. Samba provides cross-platform file and print services sharing for various Microsoft Windows, OS X and Linux file sharing. Samba services are implemented as two domains:

- smbd, which provides the file and printer sharing services.
- nmbd, which provides the NetBIOS-to-IP-address name service.

In order for Raspberry Pi to act as SMB server, install the Samba packages by the following command:

sudo apt-get install samba samba-common-bin

To configure the samba edit the **s**mb.conf configuration file, open the file by running the command. To test if Samba working properly on the client, the following steps are to done.

They steps are:

- Open Windows Explorer.
- Right click and select **Add a network location**.
- Click **Next** and select **Choose a custom network location**.
- On Internet or Network address type "\\192.168.x.xxx\home\
- Click **Next** to connect to the SMB Server.

3.7 - WEB DESIGNING AIDING TOOLS

3.7.1 - HTML

Hyper Text Markup Language (HTML) is the standard markup language for creating web pages and web applications. With Cascading Style Sheets (CSS), and JavaScript, it forms a triad of cornerstone technologies for the World Wide Web. Web browsers receive HTML documents from a webserver or from local storage and render them into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.

HTML elements are the building blocks of HTML pages. With HTML constructs, images and other objects, such as interactive forms, may be embedded into the rendered page. It provides a means to create structured documents by denoting structural semantics for text such as headings, paragraphs, lists, links, quotes and other items. HTML elements are delineated by tags, written using angle brackets. Tags such as <img /> and <input /> introduce content into the page directly. Others such as … surround and provide information about document text and may include other tags as sub-elements. Browsers do not display the HTML tags, but use them to interpret the content of the page.

HTML can embed programs written in a scripting language such as JavaScript which affect the behaviour and content of web pages. Inclusion of CSS defines the look and layout of content. The World Wide Web Consortium (W3C), maintainer of both the HTML and the CSS standards, has encouraged the use of CSS over explicit presentational HTML since 1997.

- HTML stands for Hyper Text Markup Language.
- HTML is the standard markup language for creating web pages.
- HTML describes the structure of Web pages using markup.
- HTML elements are the building blocks of HTML pages.
- HTML elements are represented by tags.HTML tags label pieces of content such as "heading", "paragraph", "table", and so on.
- Browsers do not display the HTML tags, but use them to render the content of the page.
- All HTML documents must start with a document type declaration**: <!DOCTYPE html>**
- The HTML document itself begins with **<html>** and ends with **</html>**
- The visible part of the HTML document is between **<body>** and **</body>**
- HTML headings are defined with the **<h1>** to **<h6>** tags. <h1> defines the most important heading. <h6> defines the least important heading.
- HTML paragraphs are defined with the **<p>** tag.
- HTML links are defined with the **<a>** tag. The link's destination is specified in the **href attribute.**
- Attributes are used to provide additional information about HTML elements.
- HTML images are defined with the **<img>** tag. The source file (src), alternative text (alt), width, and height are provided as attributes.
- An HTML element usually consists of a **start** tag and **end** tag.

- The **<html>** element defines the **whole document**.
- The **<body>** element defines the **document body**.
- HTML tags are not case sensitive.
- The HTML **
** element defines a **line break**.
- The **background-color** property defines the background color for an HTML element.
- The **color** property defines the text color for an HTML element.
- The **font-family** property defines the font to be used for an HTML element.
- The **font-size** property defines the text size for an HTML element.
- The **text-align** property defines the horizontal text alignment for an HTML element.

3.7.2 - Styling HTML with CSS

CSS stands for Cascading Style Sheets.CSS describes how HTML elements are to be displayed on screen, paper, or in other media. CSS saves a lot of work**.** It can control the layout of multiple web pages all at once.CSS can be added to HTML elements in 3 ways:

- **Inline -** by using the style attribute in HTML elements
- **Internal -** by using a <style> element in the <head> section
- **External -** by using an external CSS file.
- An inline CSS is used to apply a unique style to a single HTML element.
- An inline CSS uses the style attribute of an HTML element.

- An internal CSS is used to define a style for a single HTML page.
- An external style sheet is used to define the style for many HTML pages.
- With an external style sheet, we can change the look of an entire website by changing one file!
- The CSS color property defines the text color to be used.
- The CSS font-family property defines the font to be used.
- The CSS font-size property defines the text size to be used.
- The CSS border property defines a border around an HTML element
- In HTML, images are defined with the <img> tag.
- The <img> tag is empty, it contains attributes only, and does not have closing tag.
- We can use the style attribute to specify the width and height of an image.
- The values are specified in pixels (use px after the value)
- Alternatively, you can use the **width** and **height** attributes. Here, the values are specified in pixels by default.
- Some web sites store their images on image servers.
- Actually, you can access images from any web address in the world
- The GIF standard allows animated images
- Use the CSS **float** property to let the image float to the right or to the left of a text.

3.7.3 - PHP

- PHP is a server scripting language, and a powerful tool for making dynamic and interactive Web pages.
- PHP is a widely-used, free, and efficient alternative to competitors such as Microsoft's ASP.
- PHP is an acronym for "PHP: Hypertext Preprocessor".
- PHP scripts are executed on the server.
- PHP is free to download and use.
- PHP files can contain text, HTML, CSS, JavaScript, and PHP code.
- PHP code are executed on the server, and the result is returned to the browser as plain HTML.
- PHP files have extension ".php"
- PHP can generate dynamic page content
- PHP can create, open, read, write, delete, and close files on the server
- PHP can collect form data
- PHP can send and receive cookies
- PHP can add, delete, modify data in your database
- PHP can be used to control user-access
- PHP can encrypt data.

- With PHP we are not limited to output HTML. We can output images, PDF files, and even Flash movies.
- PHP runs on various platforms (Windows, Linux, Unix, Mac OS X, etc.)
- PHP is compatible with almost all servers used today (Apache, IIS, etc.)
- PHP supports a wide range of databases
- PHP is free. We can download it from the official PHP resource: www.php.net
- PHP is easy to learn and runs efficiently on the server side.
- It can be installed by using the command # apt-get install php5
- A PHP script can be placed anywhere in the document.
- A PHP script starts with <?php and ends with **?>**
- In PHP, all keywords (e.g. if, else, while, echo, etc.), classes, functions, and user-defined functions are not case-sensitive.
- However; all variable names are case-sensitive.
- In PHP, a variable starts with the $ sign, followed by the name of the variable
- PHP has three different variable scopes: local, static, and global.
- In PHP there are two basic ways to get output: echo and print.
- PHP supports the following data types such as String, Integer, Float (floating point numbers - also called double), Boolean, Array, Object, NULL, Resource.

- PHP divides the operators into Arithmetic operators, Assignment operators, Comparison operators, Increment/Decrement operators, Logical operators, String operators and Array operators.
- In PHP we have the following conditional statements:
    1) if statement - executes some code if one condition is true
    2) if...else statement - executes some code if a condition is true and another code if that condition is false
    3) if...elseif....else statement - executes different codes for more than two conditions
    4) switch statement - selects one of many blocks of code to be executed
- Use the switch statement to select one of many blocks of code to be executed**.**
- PHP while loops execute a block of code while the specified condition is true.
- In PHP, we have the following looping statements:
    1) while - loops through a block of code as long as the specified condition is true.
    2) do...while - loops through a block of code once, and then repeats the loop as long as the specified condition is true.
    3) for - loops through a block of code a specified number of times.
    4) foreach - loops through a block of code for each element in an array.

CHAPTER – 4

WORKING MODEL

The working model of the project along with all its components is shown in fig 4.1

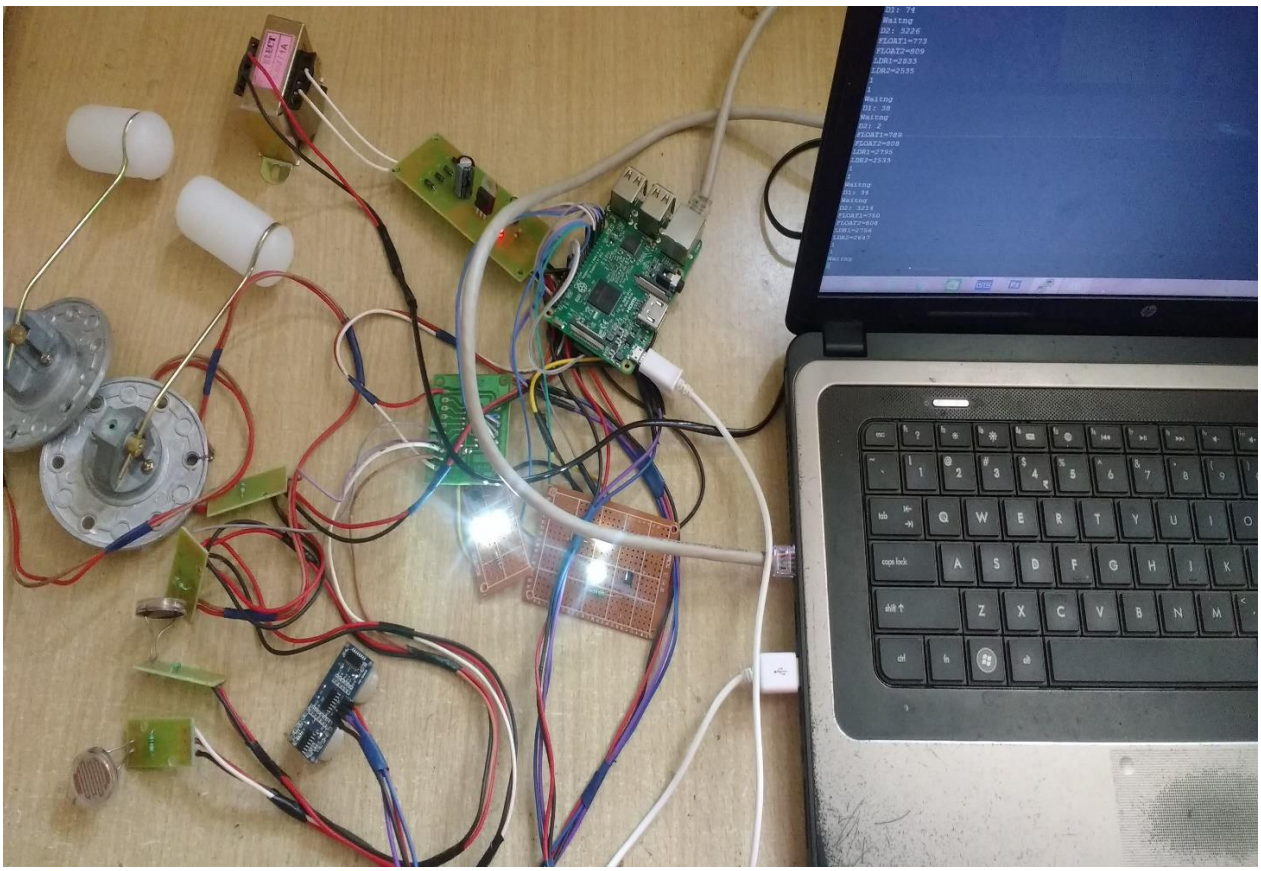

Fig 4.1- Working model

CHAPTER – 5

RESULTS & DISCUSSION

5.1 – STEPS TO VIEW THE OUTPUT

To run the program and to view the output in the website, the following steps are followed:

STEP 1: Open the puTTY icon, a puTTY configuration box appears. Enter the IP address and click "Open".

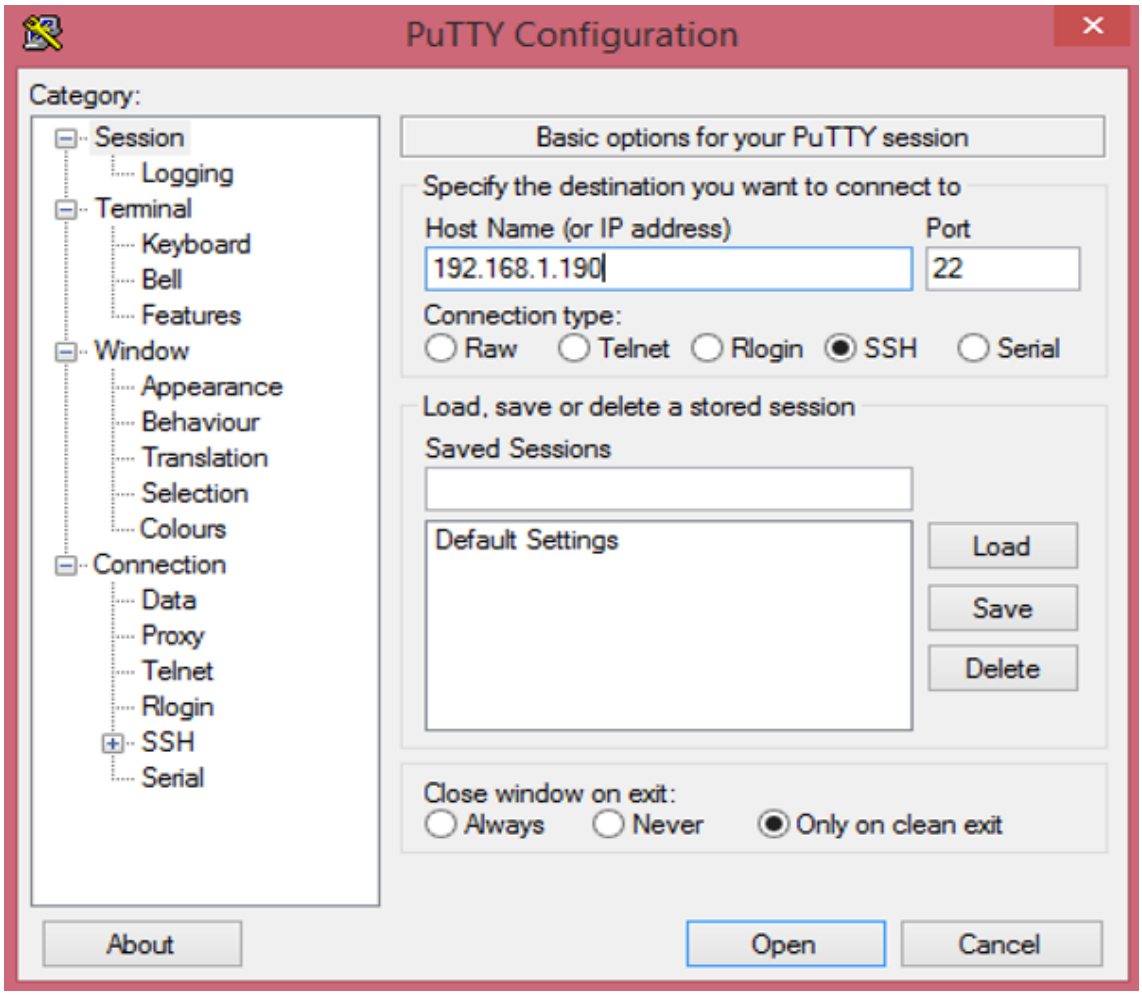

Fig 5.2- puTTY configuration box

STEP 2: Enter the username and password in the puTTY window. Then press "enter". To view the folders in the root directory enter "cd" and use the comment "ls" to display the folders and files.

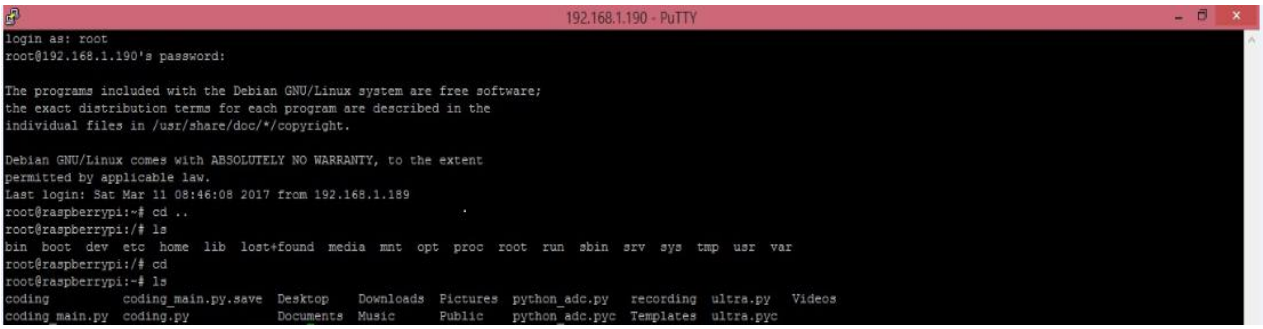

Fig 5.3- puTTY window

STEP 3: To view the codings, enter the keyword "nano" followed by the file name along with the extension and press "enter". The program file will be displayed.

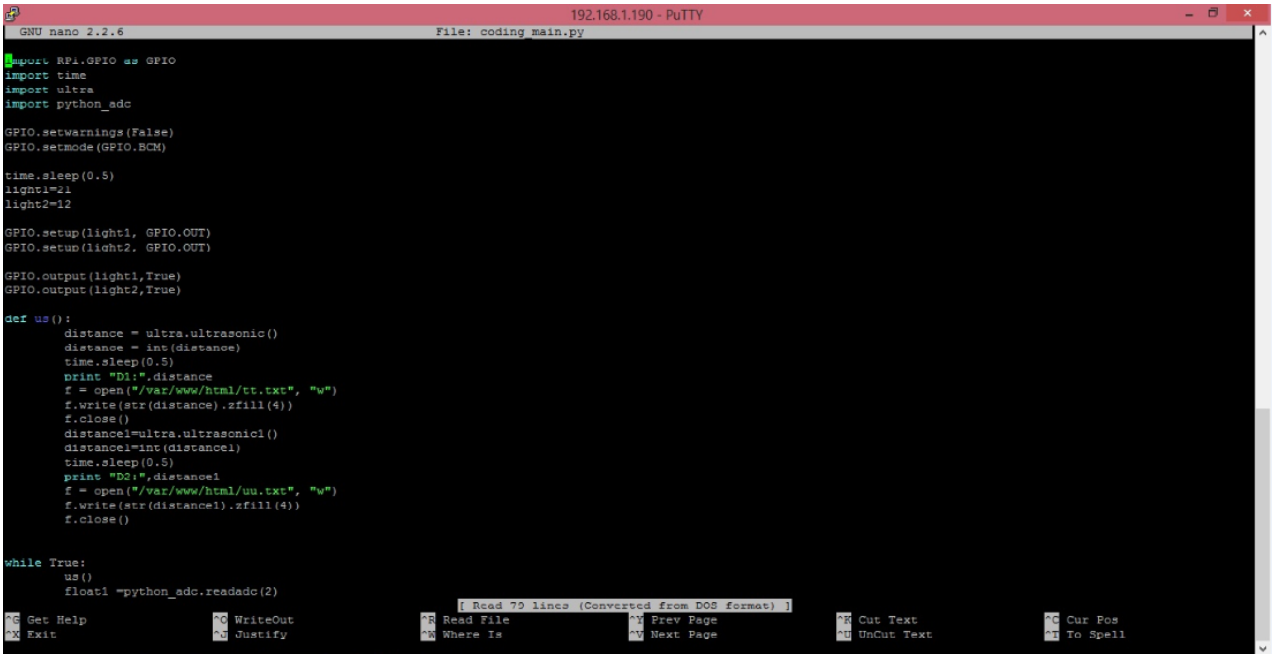

Fig 5.4- Coding window

STEP 4: To run the program, enter the keyword “python” followed by the file name along with the extension and the output values will be displayed in the window.

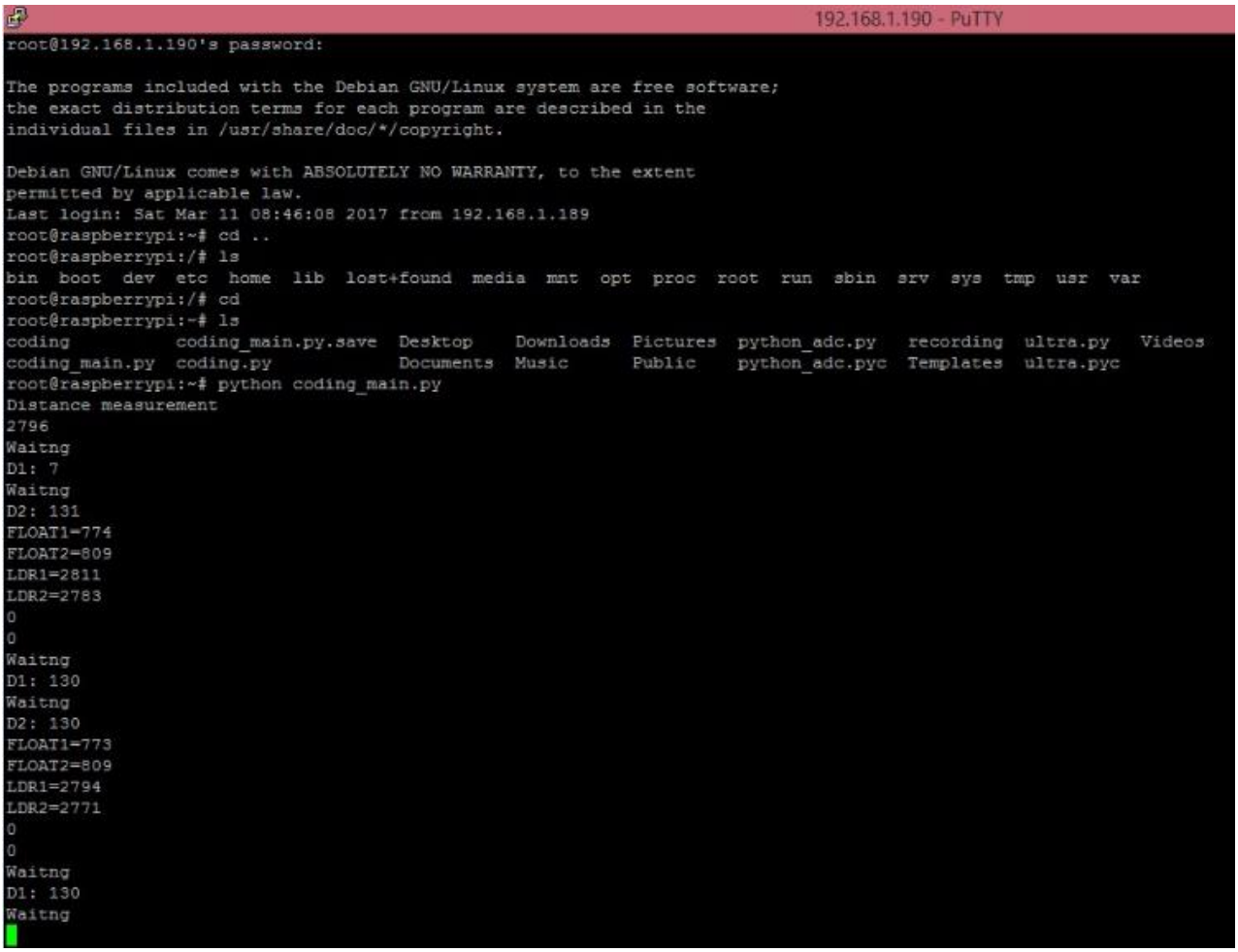

Fig 5.5- Output window

STEP 5: To view the output in the webpage, connect the ethernet cable and enter the IP address in the website. The page will be opened similar to fig.5.6 and at this instance, light 1 is OFF, light 2 is ON, ultrasonic sensor 1 is at high level (which means the garbage has no space to accommodate wastes), ultrasonic sensor 2 is at low level (which means the garbage has more space to accommodate wastes), float

sensor 1 is empty (which means the drainage is empty) and float sensor 2 is half full (which means the drainage is half filled).

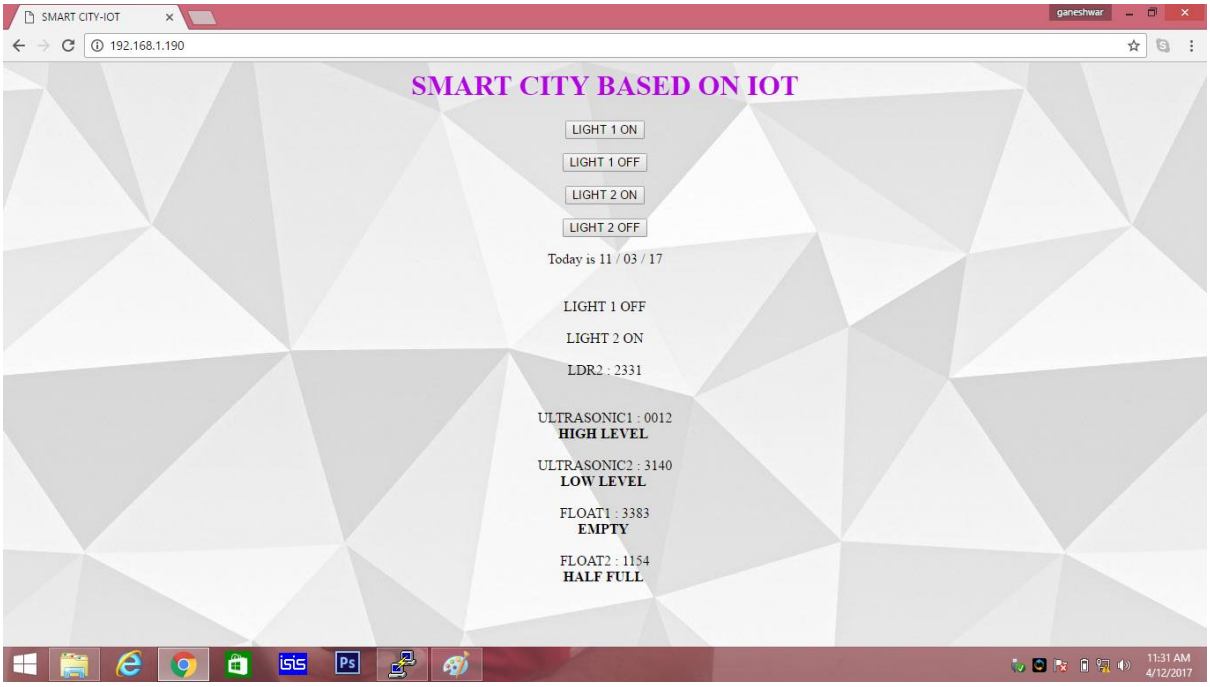

Fig 5.6- Output 1 in webpage

There are many cases where the values changes, so the result will be monitored continuously in the webpage. The different cases are displayed in the following figures:

In fig.5.7, light 1 is ON, light 2 is OFF, ultrasonic sensor 1 is at medium level (which means the garbage has half of the space to accommodate wastes), ultrasonic sensor 2 is at low level (which means the garbage has more space to accommodate wastes), float sensor 1 is half full (which means the drainage is half filled) and float sensor 2 is full (which means the drainage is completely filled).

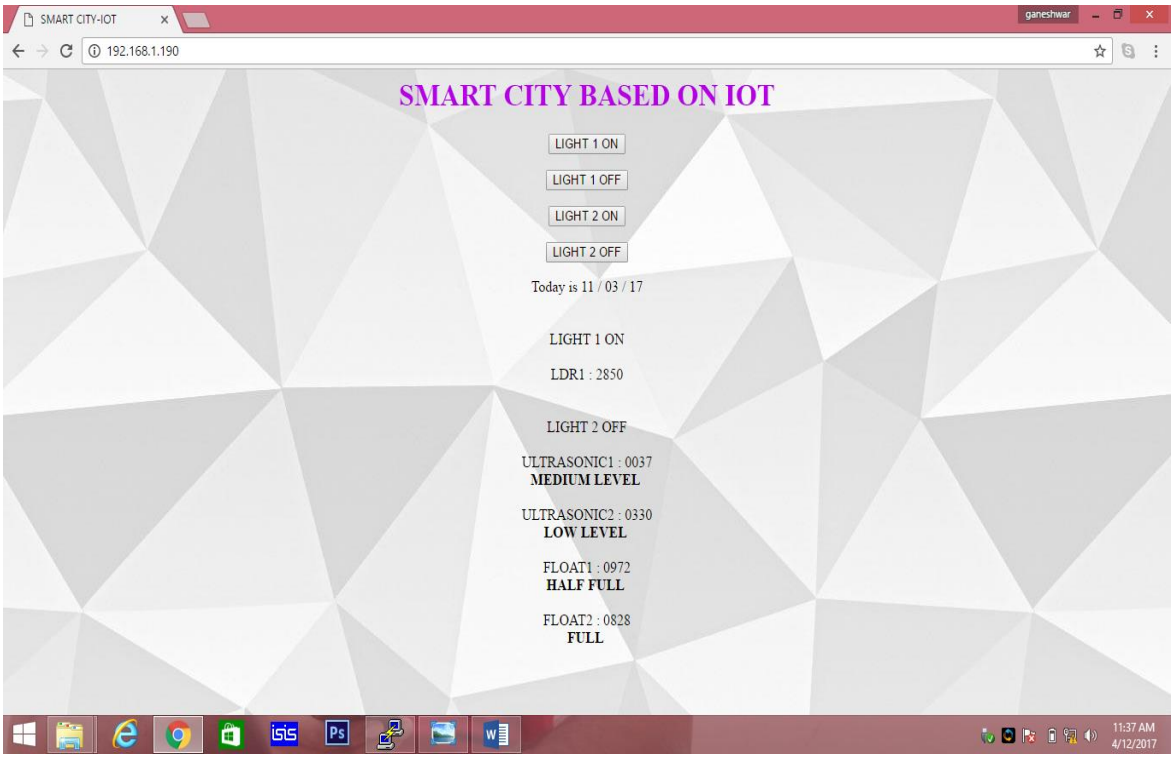

Fig 5.7- Output 2 in webpage

In fig.5.8, light 1 is ON, light 2 is ON, ultrasonic sensor 1 is at high level (which means the garbage has no space to accommodate wastes), ultrasonic sensor 2 is at high level (which means the garbage has no space to accommodate wastes), float sensor 1 is full (which means the drainage is completely filled) and float sensor 2 is full (which means the drainage is completely filled).

Fig 5.8- Output 3 in webpage

In fig.5.9, light 1 is OFF, light 2 is OFF, ultrasonic sensor 1 is at high level (which means the garbage has no space to accommodate wastes), ultrasonic sensor 2 is at low level (which means the garbage has more space to accommodate wastes), float sensor 1 is empty (which means the drainage is empty) and float sensor 2 is full (which means the drainage is completely filled).

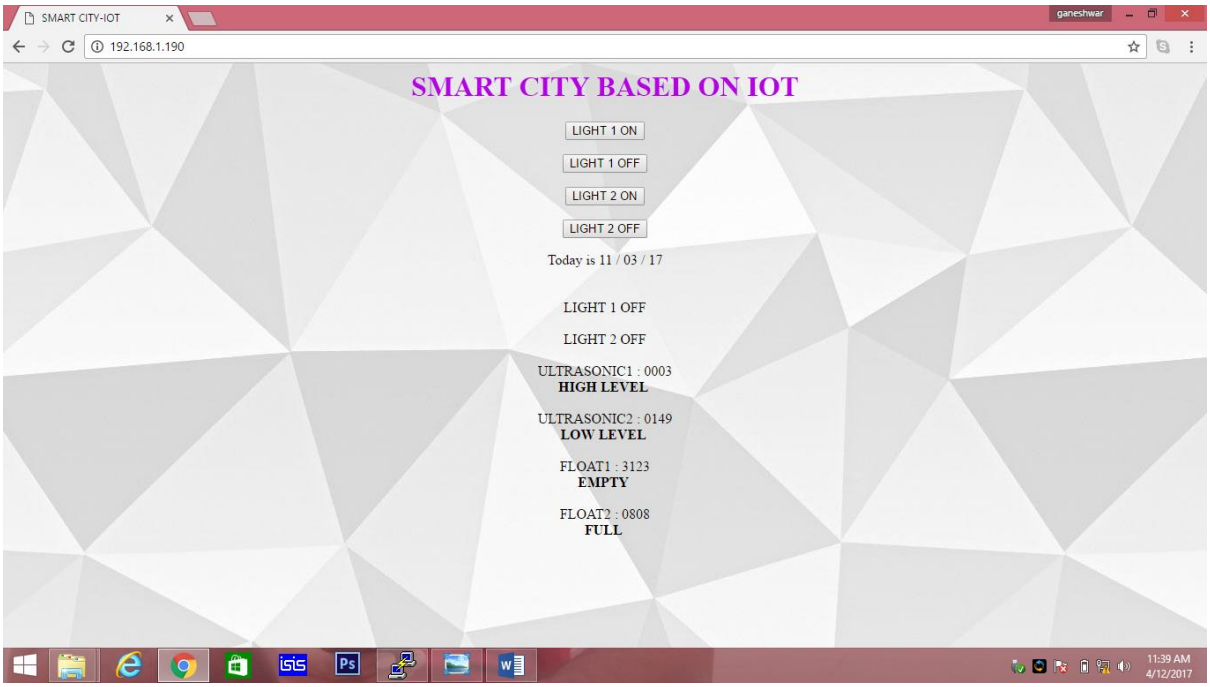

Fig 5.9- Output 4 in webpage

5.10 – INFERENCE

The output values are displayed in the webpage and the values varies continuously in real time, which will be reflected in the website also. With the help of connecting internet with the real world objects, those objects can be controlled and monitored from the website itself. This saves time and manpower. This can be implemented in a simple and efficient way to computerize the basic stuffs in the street such as street light, garbage and drainage and helps in developing the smart city.

CHAPTER – 6

CONCLUSION

It is inferred and concluded that the stuffs such as street light, garbage and drainage system can be effectively maintained by incorporating each of these with the internet, so that the current condition can be viewed parallelly on the website and the actions can be taken immediately by the concerned authority. This serves a very effective method to monitor the residential area and provide a better environment.

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