SMART RESTAURENT MANAGEMENT

A PROJECT REPORT

Submitted by

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LDRP INSTITUTE OF TECHNOLOGY AND RESEARCH GANDHINAGAR

Electronics & Communication Engineering Department

CERTIFICATE

This is to certify that the Project Work entitled **SMART RESTAURENT MANAGEMENT** has been carried out by **RISHABH, JAIRAJ, NEEL, NIRAJ** under my guidance in fulfilment of the degree of Bachelor of Engineering in ELECTRONICS AND COMMUNICATIONS (8th Semester) of Kadi Sarva Vishwavidyalaya University, Gandhinagar during the academic year 2019-20.

Mr. Nikhil H. Patel

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ABSTRACT

From the last few decades it has been analyzed by certain researches that almost all types of industrial as well as business sectors are turning for manual work towards the robotics and automation which provides great benefits to such sectors. So in this project we are focusing to bring automation in the Restaurant Sector which is the third largest industry among all other service sectors. We are going to reduce the manpower by implementing a robot which will serve the food to the customer from kitchen to a concerned table. We have developed a robot and a real time connected device using Firebase as the mediator and developed a webpage which updates as soon as there is a change in the webpage and when our robot is ordered to go to a particular table it goes to the desired place with the help of various sensors like RFID, Ultrasonic, IR sensor which guides the robot to go to the desired place with the ordered food.

ACKNOWLEDGEMENT

It is our privilege to express our sincerest regards to our project coordinator, **Mr. Nikhil Patel Sir**, for their valuable inputs, able guidance, encouragement, whole-hearted cooperation and constructive criticism throughout the duration of our project. We deeply express our sincere thanks to our Head of Department and our mentor for encouraging and allowing us to present the project on the topic "**AUTONOMOUS VEHICLE WITH MOBILE APP (Restaurant Automation)**" at our department premises for the partial fulfillment of the requirements leading to the award of B-Tech degree. We take this opportunity to thank all our lecturers who have directly or indirectly helped our project. We pay our respects and love to our parents and all other family members and friends for their love and encouragement throughout our career. Last but not the least we express our thanks to our friends for their cooperation and support.

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INTRODUCTION

1.1 Background of Project:

Today, the shortage of manpower has become a huge conundrum for business owners, especially in the food and beverage industry. Even with the deployment of good chefs and experienced managers, restaurants tend to run into a chaos with insufficient servers. Therefore, a quick solution may be to have servers carrying heavier loads to increase efficiency. However, this solution quickly worsens as servers become fatigue and hence, unable to continue working.

Autonomous Robot for Automation in Restaurant is basically a food serving robot which delivers the food on the table of a person who has ordered his food which is a basic concept of our project. In this project use of various technologies such as Wireless Communication, Detection through Radio Frequency, Mobile application and other such techniques is done which provides effortless service. This is achieved by using different types of modules and components and each of them fulfills the particular aspect of the scheme. The modules that we have used are RFID module, Bluetooth module, Ultrasonic Sensor and Microcontroller development board. The outputs are two types of motors i.e. Servo and Dc Motor for driving the robot, Led and Siren for indication purpose.

As we are emerging in the automation sector, there is an increase in the usage of robots that can work seamlessly just like a human without possibility of human error. The automation trend is going on peak for any purpose. Whenever a normal human being sees things happening at their own which was first done by humans, they found it astonishing and praise it. This happen to

eradicate the man power but at the same time it increases the efficiency. So we have made a robot or we can also say an automated guided vehicle to serve and fetch the dishes in a restaurant. Restaurant is just one application it can be used in many other sectors where the human error is likely to happen and is not acceptable. So to eradicate the error we are making a robot. Only robots without any proper guidance or orders are just a waste of resource, so to make them work according to the need and efficiently we have also worked on the software and tried to make it very simple to understand the basics and how the system is working.

The software takes the input from user and when the robot is ordered to go to a particular place it will go to that place. We have tried to make the system more stable by making an android app that makes work easier. We have also included a real time database called Firebase which will update the order in real time and changes can be made in the system as soon as the users want to.

1.2 Problems and Solution:

Automated restaurants, are making the food industry safer, personalized and more efficient. Robots can be found throughout the restaurant industry flipping burgers to specific preferences, pouring the perfect cup of coffee or even preparing fast-casual “bowled” meals.

For the majority of the food industry, automation means largely a focus at either end of the primary packaging area, in either the raw materials and preparation areas or the secondary packaging area. Raw materials and ingredients preparation areas are normally targeted to provide more and more capacity.

Food manufacturing robots are commonly used in the dispensing, feed placement, cutting, packaging or casing of food, pick-and-placing products into containers, and sorting.

By using tech to improve processing and packaging, it can improve the shelf life and safety of food. The use of machines in the food industry also ensures quality and affordability. By using machines, it drives down the costs of keeping the food fresh and increases productivity.

Advantages commonly attributed to automation include higher production rates and increased productivity, more efficient use of materials, better product quality, improved safety, shorter workweeks for labor, and reduced factory lead times.

- Ordering food and making payments

Customers now have the choice to order in advance using their mobile phones. This form of restaurant automation reduces the need for customers to wait in line. Ordering through a phone also places less pressure on the cashiers because they are less likely to get overwhelmed by long lines.

Mobile phones can also be used to pay for orders, which leads to a decreased likelihood of cashiers making mistakes when dealing with cash transactions.

Starbucks uses this type of automation technology as it allows customers to place their orders and pay via their mobile phones.

- Scheduling employees

Arranging shifts for hourly employees can be time-consuming. Restaurants gain a wide range of benefits from being able to schedule their staff easily and conveniently. A fit for purpose scheduling system needs to include features that will backfill shifts if one of your employees cannot attend work. The system should also contain communication features that help you stay in contact with your team without the need for emails, SMS and phone calls.

- Automated menus

Automated menus are becoming increasingly popular in fast food restaurants. For example, McDonald's uses digital menus that change the display at different times of the day. Breakfast items are displayed before 10.30 a.m. and the displays change to show the lunch menu from 10.30 a.m. onwards.

- Self-service

Customers use self-service kiosks to reduce the time spent in line. Using automated self-service kiosks also helps customers order more accurately as they can review orders without the pressure of feeling like they are holding up the line.

Chapter: 2

Block Diagram & Circuit Diagram

2.1 Block Diagram:

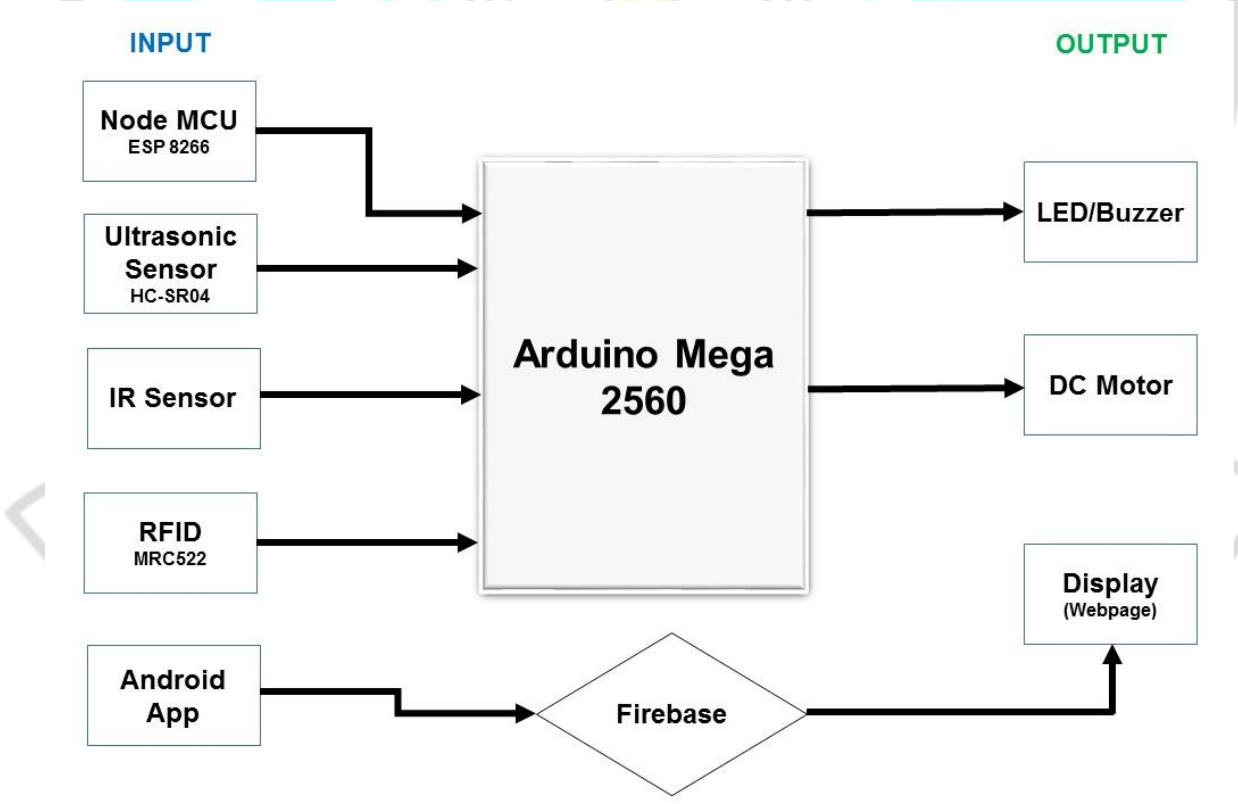

Fig. 2.1

(Block Diagram)

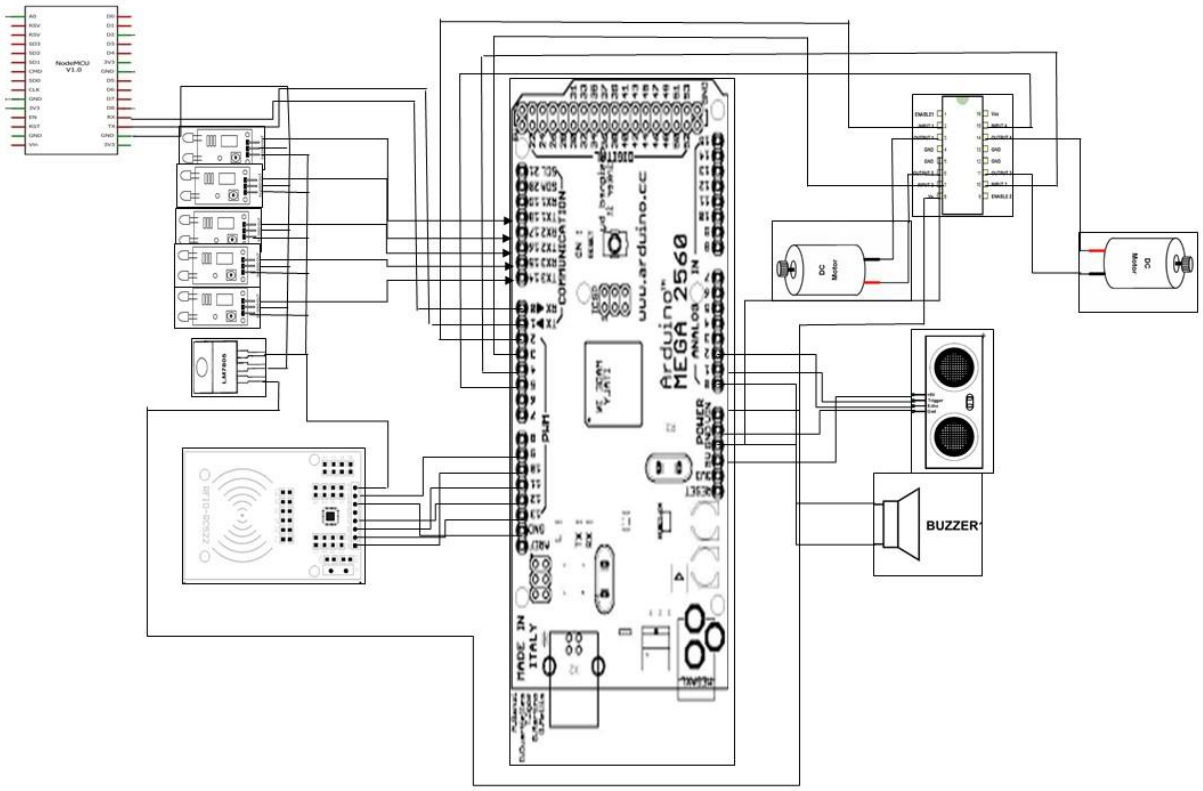

Fig. 2.2

(Circuit Diagram)

Chapter: 3

Components

3.1 Arduino Mega 2560:

Introduction

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++.

What's on the board?

There are many varieties of Arduino boards that can be used for different purposes. Some boards look a bit different from the one below, but most Arduinos have the majority of these components in common:

- Power (USB / Barrel Jack)
- Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF)

- GND (3)
- 5V & 3.3V
- Analog
- Digital
- PWM
- AREF
- Reset Button
- Power LED Indicator
- TX RX LEDs
- Main IC
- Voltage Regulator

The Arduino Family

Arduino makes several different boards, each with different capabilities. In addition, part of being open source hardware means that others can modify and produce derivatives of Arduino boards that provide even more form factors and functionality.

Arduino Uno:

The Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, a reset button and more.

Different Types of Arduino Boards

- Arduino Uno (R3)
- LilyPad Arduino.
- Red Board.
- Arduino Mega (R3)
- Arduino Leonardo.

The Extended Family

Sensors

With some simple code, the Arduino can control and interact with a wide variety of sensors - things that can measure light, temperature, degree of flex, pressure, proximity, acceleration, carbon monoxide, radioactivity, humidity, barometric pressure, you name it, you can sense it!

Just a few of the sensors that are easily compatible with Arduino

Shields

Additionally, there are these things called shields -- basically they are pre-built circuit boards that fit on top of your Arduino and provide additional capabilities -- controlling motors, connecting to the internet, providing cellular or other wireless communication, controlling an LCD screen, and much more.

Arduino Mega 2560:

The Arduino Mega is like the UNO's big brother. The microcontroller board like “Arduino Mega” depends on the ATmega2560 microcontroller.

3.1.1 Specifications

Microcontroller	**ATmega2560**
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
ADC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm
Weight	37 g
USB Port	Yes
DC Power Jack	Yes
Wi-Fi	No
Shield Compatibility	Yes

Table 3.1

(Arduino Mega 2560 Specification)

3.1.2 Pin Configuration

The pin configuration of this Arduino mega 2560 board is shown below. All analog pins of this board can be used as digital I/O pins. These boards offer flexible work memory space is the more & processing power that permits to work with different types of sensors without delay. When we compare with other types of Arduino boards, these boards are physically superior. These pins are used for providing o/p regulated voltage approximately 5V. This RPS provides the power to the microcontroller as well as other components which are used over the Arduino mega board.

Pin Number	**Pin Description**
D0 – D53	54 Digital Input / Output Pins.
A0 – A15	16 Analog Input / Output Pins.
D2 – D13	12 Pulse Width Modulation (PWM) Pins.
Pin # 0 (RX), Pin # 1 (TX) **Pin # 19 (RX1), Pin # 18 (TX1)** **Pin # 17 (RX2), Pin # 16 (TX2)** **Pin # 15 (RX3), Pin # 14 (TX3)**	4 Serial Communication Ports (8 Pins).
Pin # 50 (MISO) **Pin # 51 (MOSI)** **Pin # 52 (SCK)** **Pin # 53 (SS)**	SPI Communication Pins.
Pin # 20 (SDA), **Pin # 21 (SCL)**	I2C Communication Pins.
Pin # 13	Built-In LED for Testing.

Table 3.2

(Pin configuration of Arduino Mega 2560)

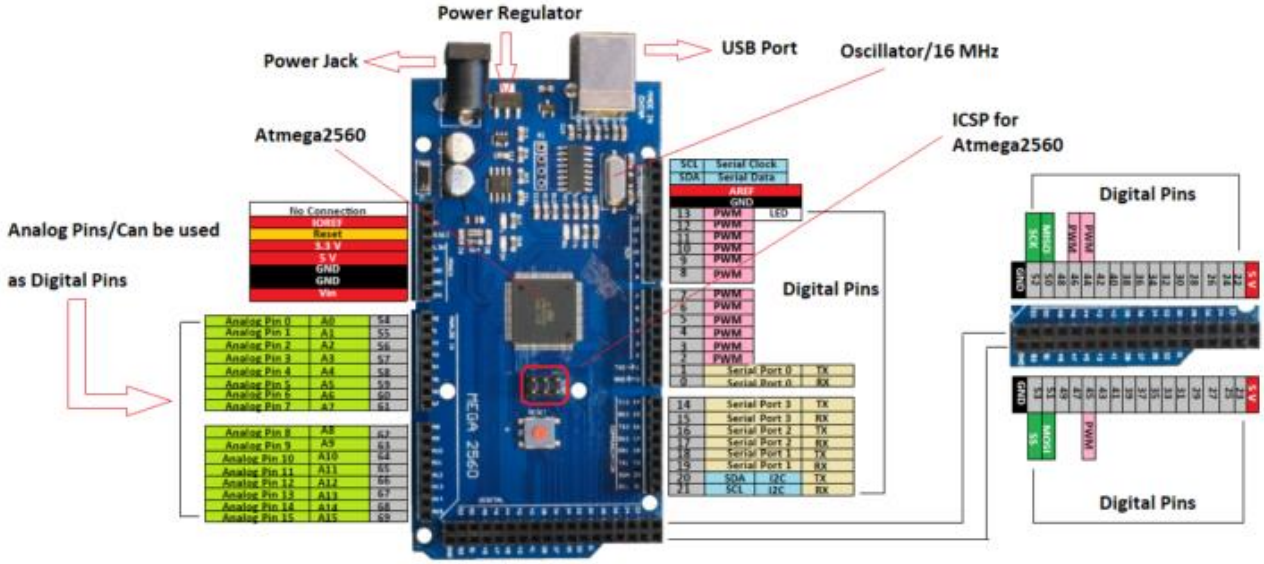

Fig. 3.1

(Arduino Mega 2560)

GND Pin: The Arduino mega board includes 5-GND pins where one of these pins can be used whenever the project requires.

Reset (RST) Pin: The RST pin of this board can be used for rearranging the board. The board can be rearranged by setting this pin to low.

Vin Pin: The range of supplied input voltage to the board ranges from 7volts to 20volts. The voltage provided by the power jack can be accessed through this pin. However, the output voltage through this pin to the board will be automatically set up to 5V.

Serial Communication: The serial pins of this board like TXD and RXD are used to transmit & receive the serial data. Tx indicates the transmission of information whereas the RX indicates receive data. The serial pins of this board have four combinations. For serial 0, it includes Tx (1) and Rx (0), for serial 1, it includes Tx (18) & Rx (19), for serial 2 it includes Tx (16) & Rx (17), and finally for serial 3, it includes Tx (14) & Rx(15).

External Interrupts: The external interrupts can be formed by using 6-pins like interrupt 0(0), interrupt 1(3), interrupt 2(21), interrupt 3(20), interrupt 4(19), interrupt 5(18). These pins produce

interrupts by a number of ways i.e. Providing LOW value, rising or falling edge or changing the value to the interrupt pins.

LED: This Arduino board includes a LED and that is allied to pin-13 which is named as digital pin 13. This LED can be operated based on the high and low values of the pin. This will give you to modify the programming skills in real time.

AREF: The term AREF stands for Analog Reference Voltage which is a reference voltage for analog inputs.

Analog Pins: There are 16-analog pins included on the board which is marked as A0-A15. It is very important to know that all the analog pins on this board can be utilized like digital I/O pins. Every analog pin is accessible with the 10-bit resolution which can gauge from GND to 5 volts. But, the higher value can be altered using AREF pin as well as the function of analog Reference.

I2C: The I2C communication can be supported by two pins namely 20 & 21 where 20-pin signifies Serial Data Line (SDA) which is used for holding the data & 21-pin signifies Serial Clock Line (SCL) mostly utilized for offering data synchronization among the devices

SPI Communication: The term SPI is a serial peripheral interface which is used to transmit the data among the controller & other components. Four pins like MISO (50), MOSI (51), SCK (52), and SS (53) are utilized for the communication of SPI.

Reset: It has reset circuit with capacitor, button and resistor to reset the controller. A push button is used to get 4 cycle low signal on reset pin to get the controller in reset mode.

Crystal: It has a crystal circuit with two capacitors and one 16 Mhz crystal for Xtal pins 1 and 2 interfacing with AVR 2560.

USART: It has TXD and RXD pin for serial communication with LED indicator.

Shield Compatibility: Arduino Mega is well-suited for most of the guards used in other Arduino boards. Before you propose to utilize a guard, confirm the operating voltage of the guard is well-

suited with the voltage of the board. The operating voltage of most of the guards will be 3.3V otherwise 5V. But, guards with high operating voltage can injure the board.

Programming: The programming of an Arduino Mega 2560 can be done with the help of an IDE (Arduino Software), and it supports C-programming language. Here the sketch is the code in the software which is burned within the software and then moved to the Arduino board using a USB cable.

An Arduino mega board includes a boot loader which eliminates an external burner utilization to burn the program code into the Arduino board. Here, the communication of the boot loader can be done using an STK500 protocol.

When we compile as well as burn the Arduino program, then we can detach the USB cable to remove the power supply from the Arduino board. Whenever you propose to use the Arduino board for your project, the power supply can be provided by a power jack otherwise Vin pin of the board.

3.2 RFID Module (RC522):

RFID or **Radio Frequency Identification** is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person.

RFID system consists of two main components, a transponder/tag attached to an object to be identified, and a Transceiver also known as interrogator/Reader. A Reader consists of a Radio Frequency module and an antenna which generates high frequency electromagnetic field. On the other hand, the tag is usually a passive device, meaning it doesn't contain a battery. Instead it contains a microchip that stores and processes information, and an antenna to receive and transmit a signal.

To read the information encoded on a tag, it is placed in close proximity to the Reader (does not need to be within direct line-of-sight of the reader). A Reader generates an electromagnetic field which causes electrons to move through the tag's antenna and subsequently power the chip.

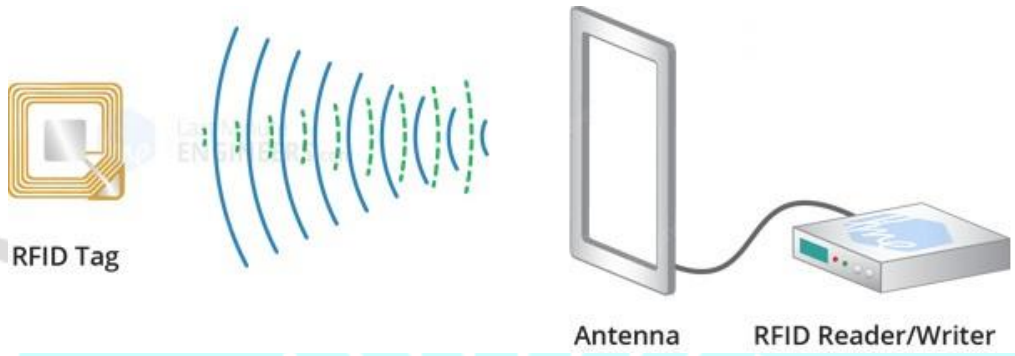

Fig. 3.2

(Working of RFID)

RFID (passive) sensors are unique in that they transmit sensor data with no battery. Types of RFID Sensors – based on radio frequency and protocol. Low Frequency (LF) 134 KHz. Ultra High Frequency (UHF) 915/868 MHz EPC.

RFID tag consists of the EEPROM memory, the Radio frequency interface and the digital control unit. Energy and data are transferred via an antenna, which consists of a coil with a few turns directly connected the chip. The EEPROM memory is divided in many sectors and blocks according to its capacity.

3.2.1 Features:

- 13.56MHz RFID module
- Operating voltage: 2.5V to 3.3V
- Communication: SPI, I2C protocol, UART
- Maximum Data Rate: 10Mbps
- Read Range: 5cm
- Current Consumption: 13-26mA
- Power down mode consumption: 10uA (min)

3.2.2 Pinout:

VCC supplies power for the module. This can be anywhere from 2.5 to 3.3 volts. You can connect it to 3.3V output from your Arduino. Remember connecting it to 5V pin will likely destroy your module!

RST is an input for Reset and power-down. When this pin goes low, hard power-down is enabled. This turns off all internal current sinks including the oscillator and the input pins are disconnected from the outside world. On the rising edge, the module is reset.

GND is the Ground Pin and needs to be connected to GND pin on the Arduino.

IRQ is an interrupt pin that can alert the microcontroller when RFID tag comes into its vicinity.

MISO / SCL / Tx pin acts as Master-In-Slave-Out when SPI interface is enabled, acts as serial clock when I2C interface is enabled and acts as serial data output when UART interface is enabled.

MOSI (Master Out Slave In) is SPI input to the RC522 module.

SCK (Serial Clock) accepts clock pulses provided by the SPI bus Master i.e. Arduino.

SS / SDA / Rx pin acts as Signal input when SPI interface is enabled, acts as serial data when I2C interface is enabled and acts as serial data input when UART interface is enabled. This pin is usually marked by encasing the pin in a square so it can be used as a reference for identifying the other pins.

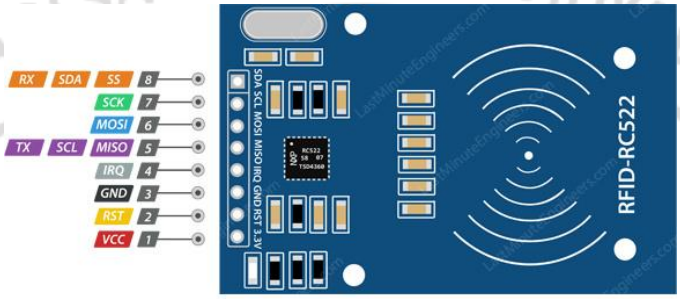

Fig. 3.3

(RFID-RC522 Pin out)

3.2.3 Benefits of RFID Asset Tracking:

- Increase asset visibility. Imagine being able to immediately locate everything you've ever misplaced or lost. ...
- Improve employee productivity. As mentioned, RFID technology does not require employees to be within the line of sight of an item or asset to locate it. ...
- Mitigate risk, theft and loss.

3.2.4 Applications:

- Automatic billing systems
- Attendance systems
- Verification/Identification system
- Access control systems

3.3 Ultrasonic Sensor(HC-SR04):

3.3.1 Features:

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

- Quiescent Current − <2mA
- Measuring Angle − 30 degree

3.3.2 Working:

HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

$$distance = \frac{speed\ of\ sound \times time\ taken}{2}$$

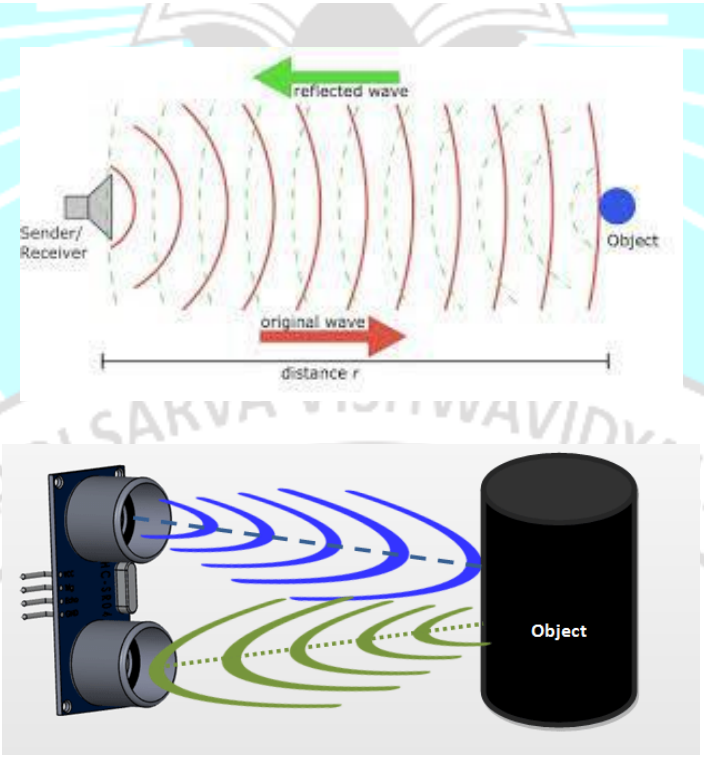

Fig. 3.4

(Working of Ultrasonic Sensor)

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module.

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

Ultrasonic methods of NDT use beams of mechanical waves (vibrations) of short wavelength and high-frequency, transmitted from a small probe and detected by the same or other probes. ... Transducers and coupling wedges are available to generate waves of several types, including longitudinal, shear and surface waves.

3.3.3 How to use the HC-SR04?

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

Fig. 3.5

(Ultrasonic HC-SR04)

Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information, the distance is measured as explained in the above heading.

3.3.4 Applications:

- Used to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.
- Used to measure the distance within a wide range of 2cm to 400cm
- Can be used to map the objects surrounding the sensor by rotating it
- Depth of certain places like wells, pits etc. can be measured since the waves can penetrate through water

3.4 Node MCU (ESP 8266):

NodeMCU is a low-cost open source IoT platform. It initially included firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which was based on the ESP-12 module. Later, support for the ESP32 32-bit MCU was added.

The firmware uses the Lua scripting language. The firmware is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson

and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

a WiFi microchip has no more than 5mm length and can be powered with as low as 10 micro Amps during sleep period. The ESP8266 arduino compatible module is a low-cost Wi-Fi chip with full TCP/IP capability, and the amazing thing is that this little board has a MCU (Micro Controller Unit) integrated which gives the possibility to control I/O digital pins via simple and almost pseudo-code like programming language. This device is produced by Shanghai-based Chinese manufacturer, Espressif Systems.

This chip was first time seen in August 2014, in ESP-01 version module, made by AI-Thinker, a third-party manufacturer. This little module allows the MCU to connect to WiFi network and create simple TCP/IP connections.

3.4.1 Features:

1.Frequency:80-160MHz

2. Processor: Tensilica Xtensa Diamond Standard 106 Micro

3. 16 GPIO pins

4. 10-bit ADC

5. IEEE 802.11 protocol for Wi-Fi

3.4.2 ESP8266 comes with capabilities of

- 2.4 GHz Wi-Fi (802.11 b/g/n, supporting WPA/WPA2),
- general-purpose input/output (16 GPIO),
- Inter-Integrated Circuit (I²C) serial communication protocol,
- analog-to-digital conversion (10-bit ADC)

- Serial Peripheral Interface (SPI) serial communication protocol,
- I²S (Inter-IC Sound) interfaces with DMA (Direct Memory Access) (sharing pins with GPIO),
- UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2),
- pulse-width modulation (PWM).

It employs a 32-bit RISC CPU based on the Tensilica Xtensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI.

ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments.

To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

There are many third-party manufacturers that produce different modules based on this chip. So, the module comes with different pin availability options like,

- ESP-01 comes with 8 pins (2 GPIO pins) – PCB trace antenna.
- ESP-02 comes with 8 pins, (3 GPIO pins) – U-FL antenna connector.
- ESP-03 comes with 14 pins, (7 GPIO pins) – Ceramic antenna.
- ESP-04 comes with 14 pins, (7 GPIO pins) – No ant.

etc.

3.4.3 Pinout:

3V3: - 3.3 V Power Pin.

GND: - Ground Pin.

RST: - Active Low Reset Pin.

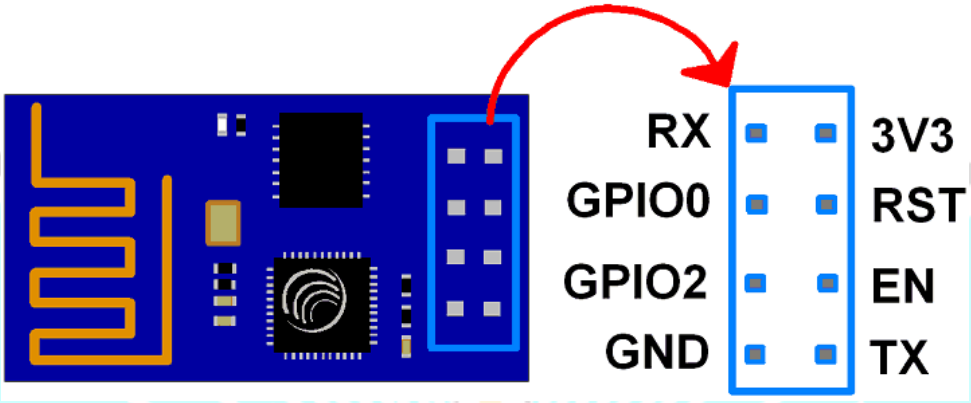

Fig. 3.6

(ESP 8266 Pin out)

EN: - Active High Enable Pin.

TX: - Serial Transmit Pin of UART.

RX: - Serial Receive Pin of UART.

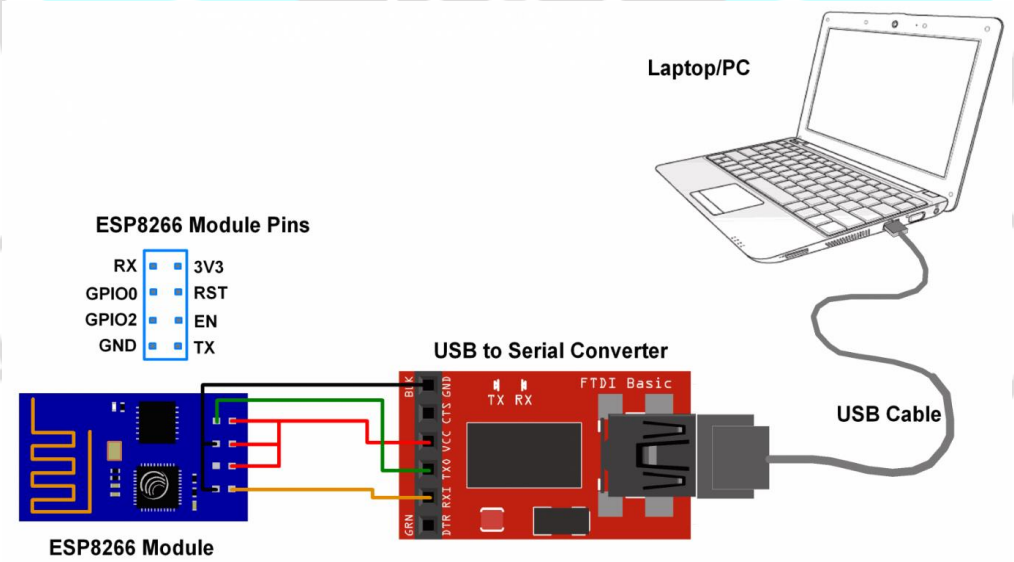

Fig. 3.7

(Working of ESP 8266)

GPIO0 & GPIO2: - General Purpose I/O Pins. These pins decide what mode (boot or normal) the module starts up in. It also decides whether the TX/RX pins are used for Programming the module or for serial I/O purpose.

To program the module using UART, Connect GPIO0 to ground and GPIO2 to VCC or leave it open. To use UART for normal Serial I/O leave both the pins open (neither VCC nor Ground)

To put ESP8266 in flash mode, make connections as per above figure (in between ESP8266 and USB to Serial converter) and then only connect it to PC/laptop. Do not forget to connect GPIO0 pin to ground.

3.5 IR Sensor:

An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation.
The infrared sensor (IR sensor) is a light-sensitive optoelectronic component with a spectral sensitivity in infrared wavelength range (850 nm ... 50 µm). **Frequency range** of approximately 430 THz down to 300 GHz.

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. PIR sensors are commonly used in security alarms and automatic lighting applications. The Passive Infrared (PIR) sensor is used to detect the presence of human. But this detects the human only if they are in motion. The **Grid-EYE sensor** detects the human using the infrared radiation radiated by the human body. Every human radiates the infrared energy of specific wavelength range.

3.5.1 Types:

Infrared sensors can be passive or active. Passive infrared sensors are basically Infrared detectors. Passive infrared sensors do not use any infrared source and detects energy emitted by obstacles in

the field of view. They are of two types: quantum and thermal. Thermal infrared sensors use infrared energy as the source of heat and are independent of wavelength. Thermocouples, pyroelectric detectors and bolometers are the common types of thermal infrared detectors.

Quantum type infrared detectors offer higher detection performance and are faster than thermal type infrared detectors. The photosensitivity of quantum type detectors is wavelength dependent. Quantum type detectors are further classified into two types: intrinsic and extrinsic types. Intrinsic type quantum detectors are photoconductive cells and photovoltaic cells.

Active infrared sensors consist of two elements: infrared source and infrared detector. Infrared sources include an LED or infrared laser diode. Infrared detectors include photodiodes or phototransistors. The energy emitted by the infrared source is reflected by an object and falls on the infrared detector.

3.5.1a IR Transmitter:

Infrared Transmitter is a light emitting diode (LED) which emits infrared radiations. Hence, they are called IR LED's. Even though an IR LED looks like a normal LED, the radiation emitted by it is invisible to the human eye. There are different types of infrared transmitters depending on their wavelengths, output power and response time. A simple infrared transmitter can be constructed using an infrared LED, a current limiting resistor and a power supply. The schematic of a typical IR transmitter is shown below.

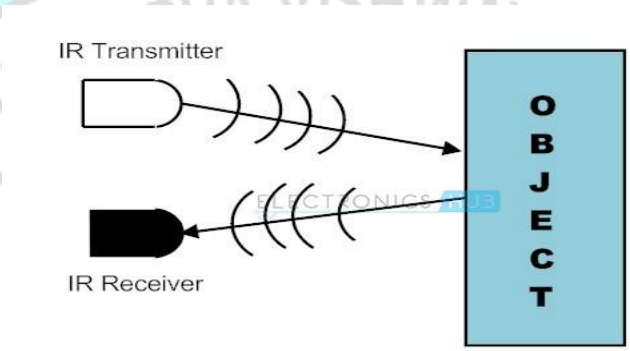

Fig. 3.8

(Working of IR Sensor)

3.5.1b IR Receiver:

Infrared receivers are also called as infrared sensors as they detect the radiation from an IR transmitter. IR receivers come in the form of photodiodes and phototransistors. Infrared Photodiodes are different from normal photo diodes as they detect only infrared radiation. Different types of IR receivers exist based on the wavelength, voltage, package, etc. When used in an infrared transmitter – receiver combination, the wavelength of the receiver should match with that of the transmitter.

It consists of an IR phototransistor, a diode, a MOSFET, a potentiometer and an LED. When the phototransistor receives any infrared radiation, current flows through it and MOSFET turns on. This in turn lights up the LED which acts as a load. The potentiometer is used to control the sensitivity of the phototransistor.

3.5.2 Distinguishing Between Black and White Colors:

It is universal that black colour absorbs the entire radiation incident on it and white colour reflects the entire radiation incident on it. Based on this principle, the second positioning of the sensor couple can be made. The IR LED and the photodiode are placed side by side. When the IR transmitter emits infrared radiation, since there is no direct line of contact between the transmitter and receiver, the emitted radiation must reflect back to the photodiode after hitting any object. The surface of the object can be divided into two types: reflective surface and non-reflective surface. If the surface of the object is reflective in nature i.e. it is white or other light colour, most of the radiation incident on it will get reflected back and reaches the photodiode. Depending on the intensity of the radiation reflected back, current flows in the photodiode.

If the surface of the object is non-reflective in nature i.e. it is black or other dark colour, it absorbs almost all the radiation incident on it. As there is no reflected radiation, there is no radiation incident on the photodiode and the resistance of the photodiode remains higher allowing no current to flow. This situation is similar to there being no object at all. The pictorial representation of the above scenarios is shown below.

The positioning and enclosing of the IR transmitter and Receiver is very important. Both the transmitter and the receiver must be placed at a certain angle, so that the detection of an object happens properly. This angle is the directivity of the sensor which is +/- 45 degrees.

In order to avoid reflections from surrounding objects other than the object, both the IR transmitter and the IR receiver must be enclosed properly. Generally, the enclosure is made of plastic and is painted with black colour.

3.5.3 LINE FOLLOWER:

The whole Arduino line follower robot can be divided into 3 sections: sensor section, control section and driver section.

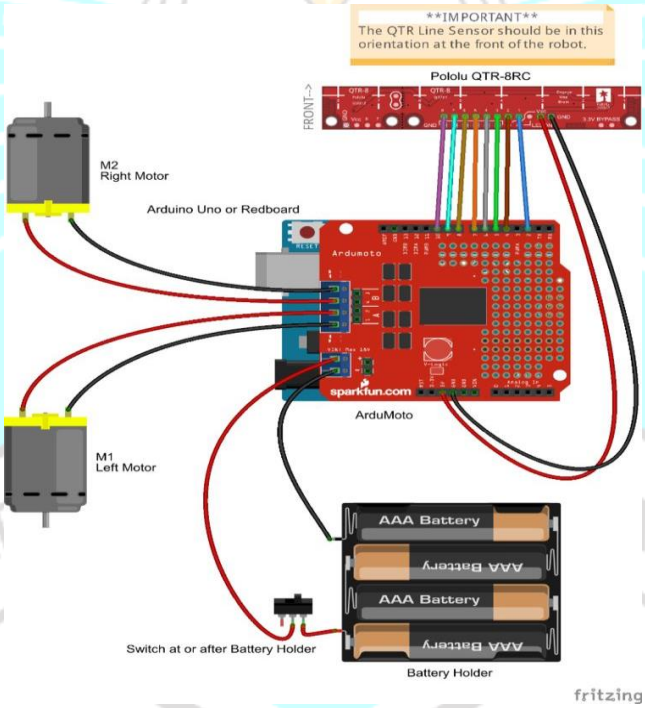

Fig. 3.9

(Line Follower)

3.5.3a Sensor section:

This section contains IR diodes, potentiometer, Comparator (Op-Amp) and LED's. Potentiometer is used for setting reference voltage at comparator's one terminal and IR sensors are used to sense the line and provide a change in voltage at comparator's second terminal. Then comparator compares both voltages and generates a digital signal at output. Here in this line follower circuit we have used two comparators for two sensors. LM 358 is used as comparator. LM358 has inbuilt two low noise Op-amps.

3.5.3b Control Section:

Arduino Pro Mini is used for controlling whole the process of line follower robot. The outputs of comparators are connected to digital pin number 2 and 3 of arduino. Arduino read these signals and send commands to driver circuit to drive line follower.

3.5.3c Driver section:

Driver section consists motor driver and two DC motors. Motor driver is used for driving motors because Arduino does not supply enough voltage and current to motor. So we add a motor driver circuit to get enough voltage and current for motor. Arduino sends commands to this motor driver and then it drive motors.

3.6 DC Motor:

The DC Motor or Direct Current Motor to give it its full title, is the most commonly used actuator for producing continuous movement and whose speed of rotation can easily be controlled, making them ideal for use in applications were speed control, servo type control, and/or positioning is required. A DC motor consists of two parts, a "Stator" which is the stationary part and a "Rotor" which is the rotating part. The result is that there are basically three types of DC Motor available.

DC motors are the most common type of motors used in robotics. DC motors appear in a large variety of shapes and sizes: permanent magnet iron core, permanent magnet ironless rotor,

permanent magnet brushless, wound field series connected, wound field shunt connected, wound field compound connected, variable reluctance stepper, permanent magnet stepper, and hybrid stepper motors.

As an estimate, 7,500 hours brush life is normal for general purpose, medium horsepower DC motors with good commutator film with commutator surface speeds in the range of 2,500 to 4,000 feet per minute.

3.6.1 Advantages:

1. Provide excellent speed control for acceleration and deceleration

2. Easy to understand design

3. Simple, cheap drive design

3.6.2 DC Motor with Microcontroller:

Microcontrollers can't drive the motors directly. So we need some kind of drivers to control the speed and direction of motors. The motor drivers will acts as interfacing devices between microcontrollers and motors. Motor drivers will act as current amplifiers since they take a low

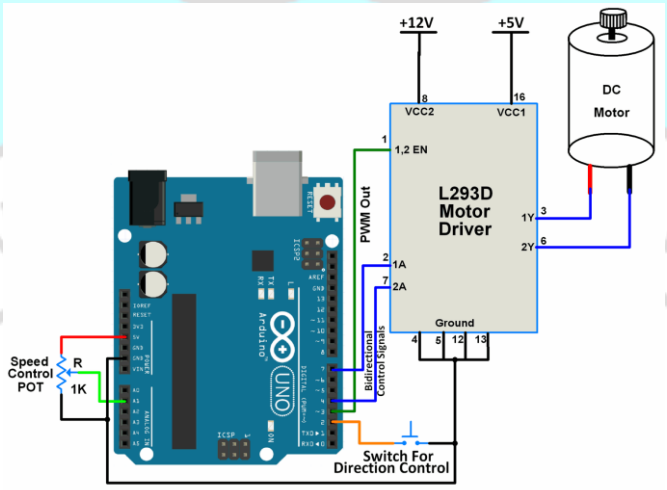

Fig. 3.10

(DC motor with Arduino)

current control signal and provide a high current signal. This high current signal is used to drive the motors. Using L293D chip is the easy way for controlling the motor using microcontroller. It contains two H-bridge driver circuits internally.

3.7 Power Supply:

3.7.1 Working:

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

A power supply takes the AC from the wall outlet, converts it to unregulated DC, and reduces the voltage using an input power transformer, typically stepping it down to the voltage required by the load. For safety reasons, the transformer also separates the output power supply from the mains input.

A DC (direct current) power supply convert electrical energy in the form delivered by the power company to a form required by some device. DC power supplies are usually designed to supply energy at a certain voltage and current.

12V power supplies (or 12VDC power supplies) are one of the most common power supplies in use today. Linear regulated 12VDC power supplies regulate the output using a dissipative regulating circuit. They are extremely stable, have very low ripple, and have no switching frequencies to produce EMI.

3.7.2 Function of a DC power supply:

DC power supplies are power supplies which produce an output DC voltage. Power supplies are devices that deliver electric power to one or several loads. They generate the output power by converting an input signal into an output signal (in this case, a DC output).

If your device needs 9V, you need a 9V power supply. If your device needs 5V, you need a 5V supply. Also, if your device needs a DC voltage (which is the most common), you need a DC output from your power supply. DC power is widely used in low voltage applications such as charging batteries, automotive applications, aircraft applications and other low voltage, low current applications.

This is a 5V power supply circuit which is used for giving power to the Arduino. This is because the Arduino cannot use the AC power 230V directly from the main supply. So, we he first converts it to DC current after that we have to bring its voltage down to SV so that Arduino can handle that power. The AC can be converted in DC with the help of the Diode Biased which is made of four diodes and the power can be toned with help of IC 17805.

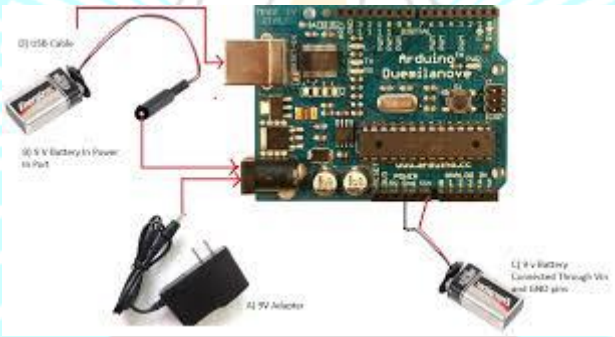

Fig. 3.11

(12V Adapter with Arduino)

Chapter: 4

Getting into Software

4.1 Introducing the software:

Languages used are JavaScript, HTML and CSS.

4.2 What is JavaScript?

JavaScript is a very powerful client-side scripting language. JavaScript is used mainly for enhancing the interaction of a user with the webpage. In other words, you can make your webpage livelier and interactive, with the help of JavaScript. JavaScript is also being used widely in game development and Mobile application development.

Being a scripting language, JavaScript cannot run on its own. In fact, the browser is responsible for running JavaScript code. When a user requests an HTML page with JavaScript in it, the script is sent to the browser and it is up to the browser to execute it. The main advantage of JavaScript is that all modern web browsers support JavaScript. So, you do not have to worry about whether your site visitor uses Internet Explorer, Google Chrome, Firefox or any other browser. JavaScript will be supported. Also, JavaScript runs on any operating system including Windows, Linux or Mac. Thus, JavaScript overcomes the main disadvantages of VBScript (Now deprecated) which is limited to just IE and Windows.

4.3 What is 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.

External stylesheets are stored in CSS files. CSS is used to define styles for your web pages, including the design, layout and variations in display for different devices and screen sizes.

4.4 What is HTML:

HTML is the standard markup language for creating Web pages.

- HTML stands for Hyper Text Markup Language
- HTML describes the structure of a Web page
- HTML consists of a series of elements
- HTML elements tell the browser how to display the content
- 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

Chapter: 5

Workflow

To control the AGV we need to develop application so that we made one application by using MIT (Massachusetts Institute of Technology) App Inventor. The application will help the hardware body to detect the right path and serve food on specific table number. Furthermore, we made the application but we have to put the data which will be shown in the smart menu. So we use “FIREBASE” extension to fill the data i.e. item name & Quantity. To finalize the order user, have to submit that order by just pressing “SUBMIT”. After submitting the data, that data will directly go to firebase and it will have displayed in kitchen’s TV that this number of table ordered 3 items. So we have programmed that whenever the firebase gets update the program will also update the webpage. We made webpage by using HTML, CSS, JAVA SCRIPT.

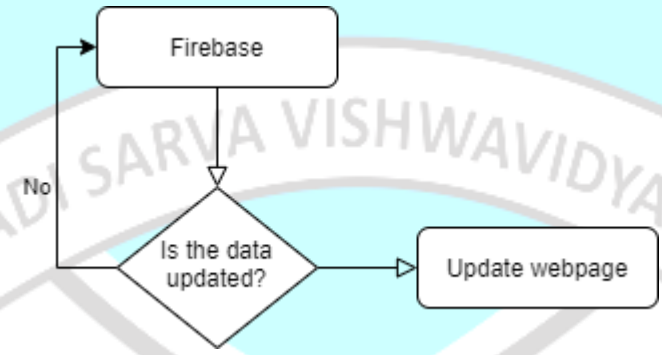

Fig. 5.1

(Flow chart of Application)

As the user input is fetched. Now, As the user input is fetched, the chef from the kitchen orders the robot to go to a particular place and then the robot working is shown in chapter 6 and 7.

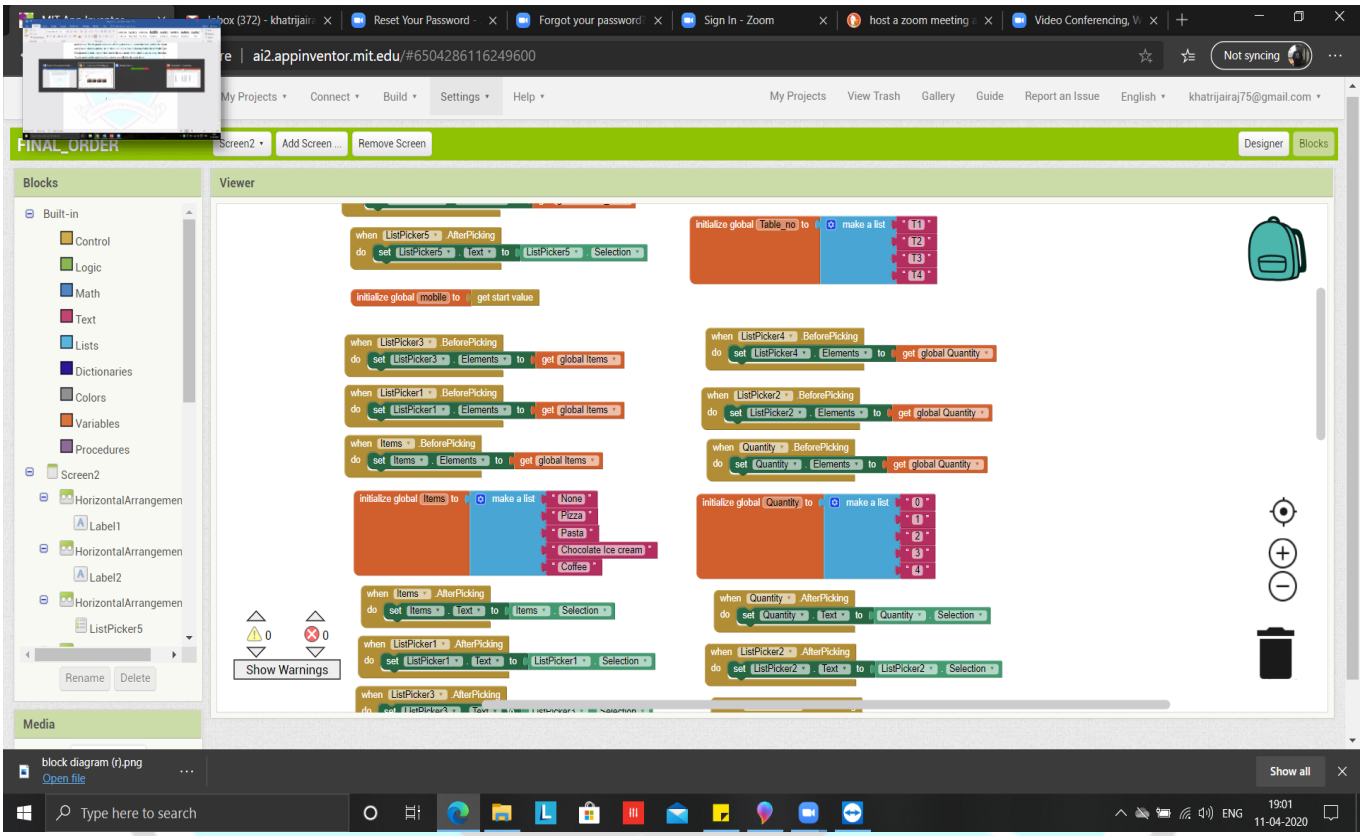

Fig. 5.2

(Working of Application1)

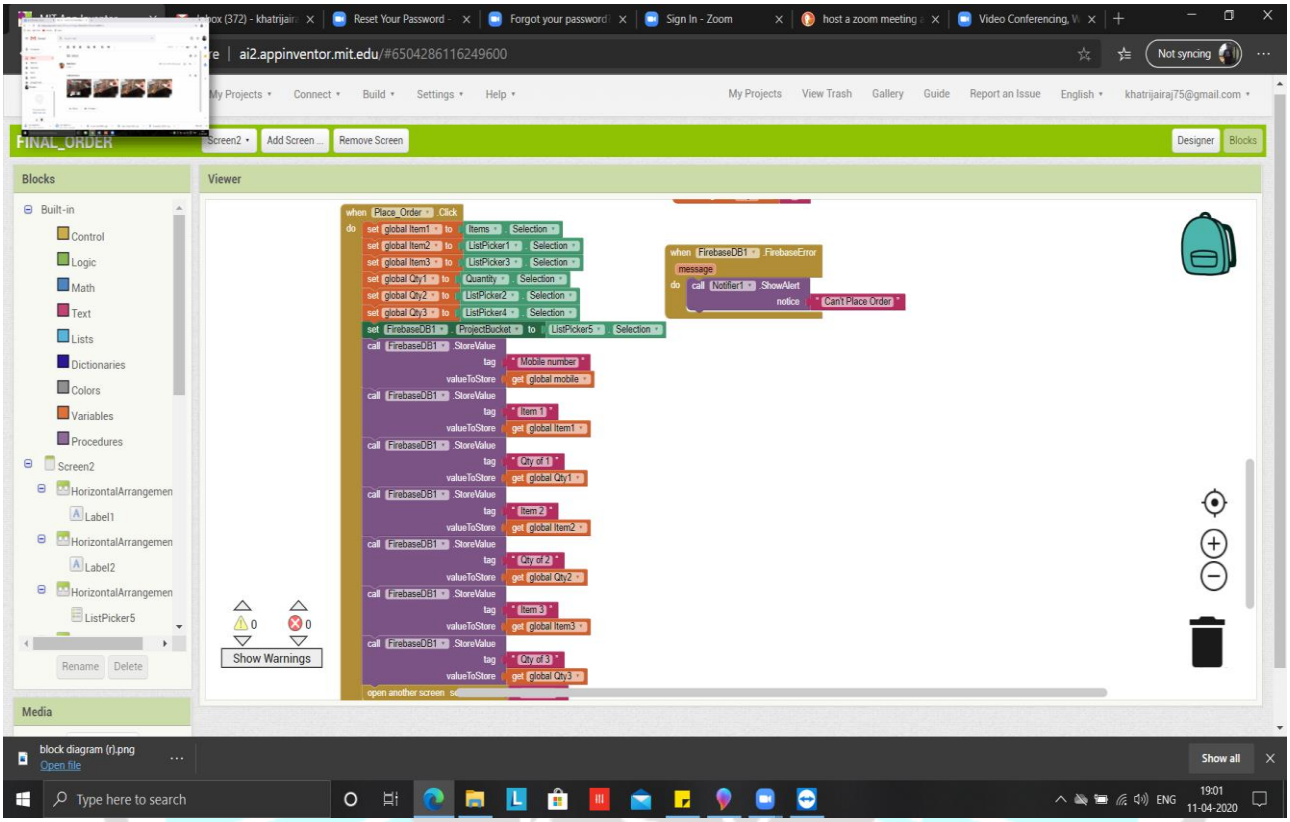

Fig. 5.3

(Working of Application2)

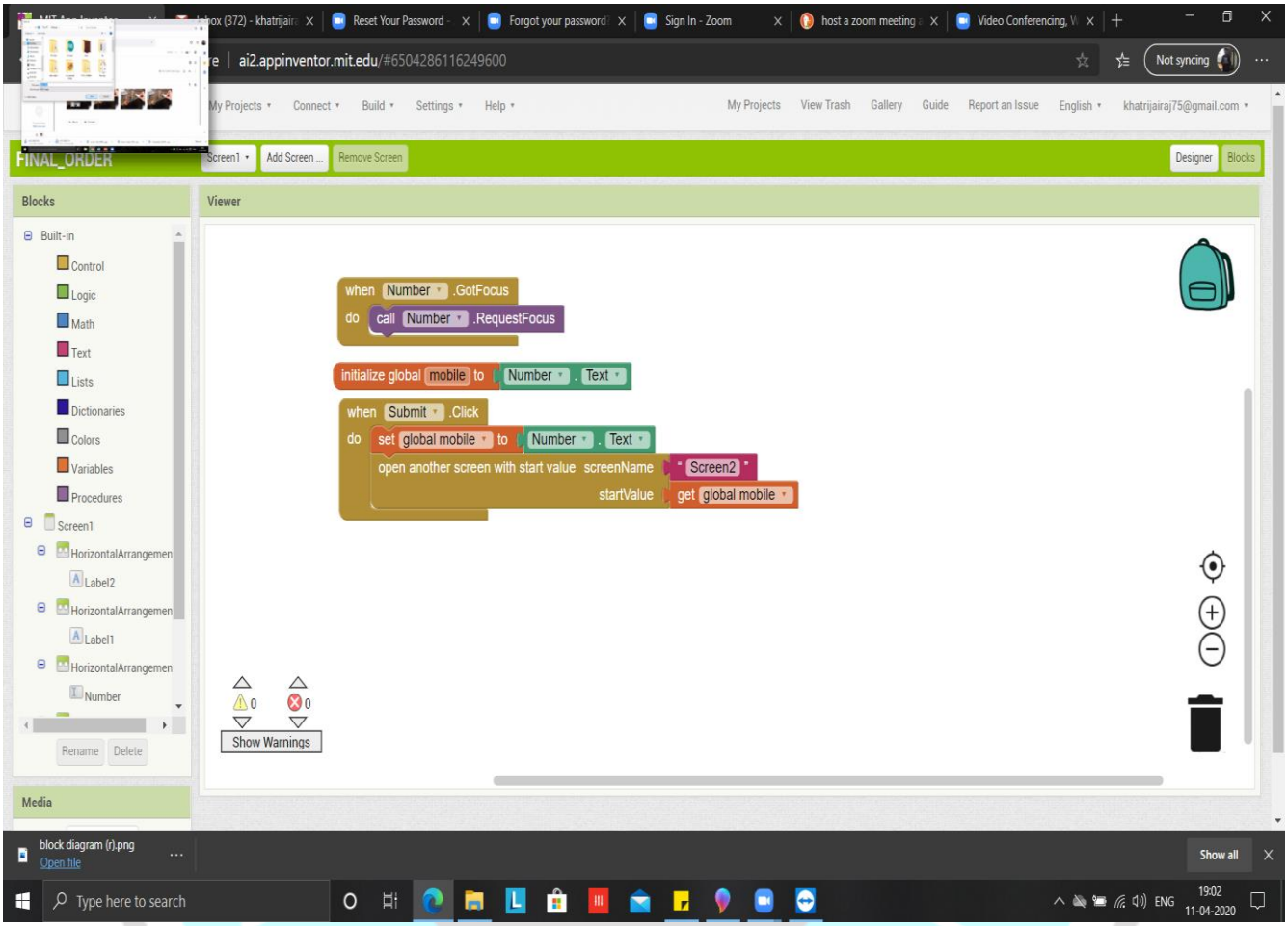

Fig. 5.4

(Working of Application3)

Chapter: 6

AGV

(AUTOMATED GUIDED VEHICLE)

6.1 Introduction:

With the technological advancement in the field of machineries, there have been various attempts to improve the material handling techniques. AGV (Automated Geared Vehicle) is one of the remarkable machine which helps in various tasks such as fork lifting objects, towing, product transportation etc., without the continuous monitoring of human.

An AGV works with the simultaneous processing of various parts. The control device which is common to both the driving device and transfer device operates the vehicle and maintains the ultimate process of automated guided vehicle. Proximity sensors are set up to detect the vehicle movement which directly controls the start and stop process of AGV. Photo sensors are incorporated to detect the material or object in the station. A material transfer system includes loading and unloading of material through set of specific device, in which the electrical connections are interconnected.

6.2 History:

The first AGV developed by A.M.Barnet (1953) who used overhead wire to navigate the vehicle in grocery shop. The use of AGV has grown enormously since their introduction, the number of area of application and variation type has increased significantly. Recently AGV extended their popularity to other application. Depak punithe (IJRAS august 2013) developed an AGV to betterment public health care system. we can use AGV as serving robot in hotel, material handling robot in warehouse and improve the health care system. At manufacturing area AGV are capable to transport all type of material related to manufacturing process. According to Gotte (2000) the usage of AGV will pay off for manufacturing environment (like distribution, transportation, and transhipment) with repeating transpiration pattern. He described different available technology for automation in container terminal. The control device receives signal from the transfer device once transferring gets completed and transmits signal to the driving system to move the vehicle to the next destination point. In accordance with the flow path, the colored tape method is best suited to this vehicle for best outcome. The best flow path is designed considering all aspects. It is a battery powered vehicle in which it charges automatically. Inductive power transfer methods were implemented in the vehicle to enhance better performance.

An AGV can also be called a laser guided vehicle (LGV). In Germany the technology is also called Fahrerlose Transport system (FTS) and in Sweden förarlösa truckar. Lower cost versions of AGVs are often called Automated Guided Carts (AGCs) and are usually guided by magnetic tape. AGCs are available in a variety of models and can be used to move products on an assembly line, transport goods throughout a plant or warehouse, and deliver loads.

Although, most of the AGVs use some mark or defined path to move on, works are going on to develop such an AGV having artificial intelligence which can be dynamic in the sense of navigation and whose locomotion is not limited to just retrofit workspace.

6.3 Characteristics:

Automated Guided Vehicles can be used in a wide variety of applications to transport many different types of material including pallets, rolls, racks, carts, and containers. AGVs excel in applications with the following characteristics:

- Repetitive movement of materials over a distance
- Regular delivery of stable loads
- Medium throughput/volume
- Operations with at least two shifts
- Processes where tracking material is important
- Clear floor space
- No floor deck construction
- Simple installation
- High availability/reliability
- Flexible performance increments
- Short installation times
- Simple expansion
- Reduces the labour cost.
- Flexible.
- Intelligent.
- Time consuming.
- Can significantly reduce production & warehouse costs.

6.4 Applications:

AGV is a material handling system that uses independently operated, self-propelled vehicles guided along defined pathways.

AGVs increase efficiency and reduce costs by helping to automate a manufacturing facility or warehouse.

AGVs can carry loads or tow objects behind them in trailers. The trailers can be used to move raw materials or finished product. The AGV can also store objects on a bed. some AGVs use fork lifts to lift objects for storage. AGVs are employed in nearly every industry, including, paper, metals, newspaper and general manufacturing.

The objects can be placed on a set of motorized rollers (conveyor) and then pushed off by reversing them. AGVs are employed in nearly every industry, including pulp, paper, metals, newspaper, and general manufacturing. Transporting materials such as food, linen or medicine in hospitals is also done.

6.5 Types of navigation:

- Wired navigation
- Guide tape navigation
- Laser target navigation

A. Wired navigation:

- The wired sensor is placed on bottom of the AGV'S and is placed facing the ground.
- A slot is cut in the ground and a wire is placed approximately 1 inch below the ground.
- The sensors detect the radio frequency being transmitted from the wire and follows it.

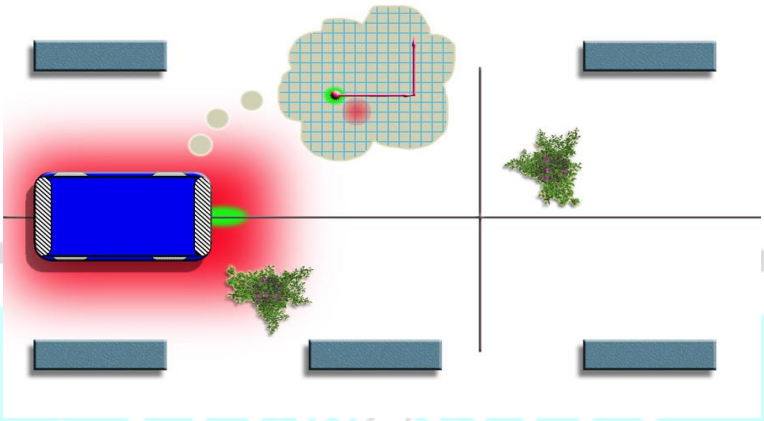

Fig. 6.1

(Wired Navigation)

B. Guide tape navigation:

- The AGV'S (some known as automated guided carts or AGC'S) use magnetic tape for the guide path.
- The AGC'S is fitted with the appropriate guide sensors to follow the path of the tape.
- It is considered a "passive" system since it does not require the guide medium to be energized as wire does.

Fig. 6.2
(Guide tape navigation)

C. Laser target navigation:

- The AGV'S carry's a laser transmitter and receiver on a rotating turret.
- The laser is sent off then received again the angle and distances are automatically calculated and stored into AGV'S memory.
- The AGV'S has reflector map stored in memory and can correct its position based on errors between the expected and received measurements.
- It can then navigate to a destination target using the constantly updating position.

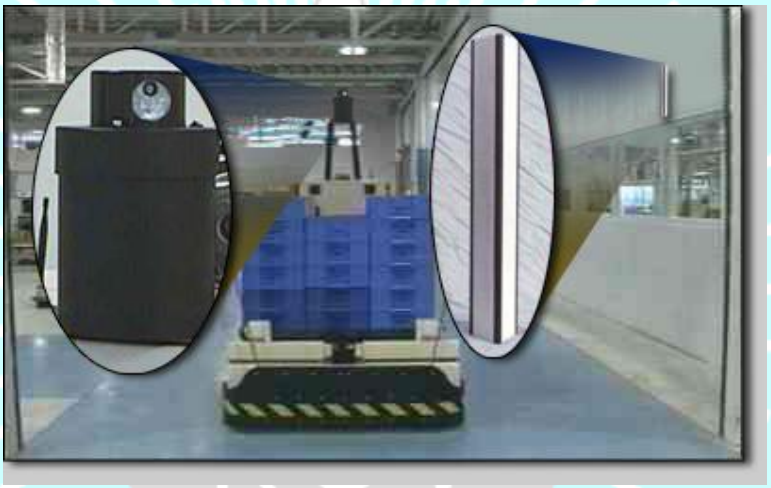

Fig. 6.3

(Laser target navigation)

Chapter: 7

AGV using Line Follower

7.1 WHAT IS LINE FOLLOWER AGV?

An automated guided vehicle is a programmable mobile vehicle. The automated guided vehicle is used in industrial application to move material around a manufacturing facility. The AGV are capable of transportation task fully automated at low expanses. AGV have to make the system automatic by doing the decision on the path selection. This is done through different method frequency selected mode, path selected mode and vision based mode etc. The central processing system of AGV is issue the steering command and speed command. For the pre-defined manufacturing environment, the line follower robot is good option for choice. A line follower robot is a robot which follows a pre-defined path controlled by a feedback mechanism. The path can be visible like a black line on a white surface (or vice versa) or it can be invisible like a magnetic field. Sensing a line and guiding the robot to stay on course, while constantly correcting.
Some of the practical applications of a line follower are industrial applications were these robots can be used as automated equipment carriers in industries replacing traditional conveyer belts in automobile. Some recent development of line follower is seen in applications such floor cleaning, guidance in public places, library assistance (thirumurgan 2010), entertainment (coalk 2009), education (Makrodimitris 2011) etc. Most commonly used technology in line following robot are done by using microcontrollers and without using microcontroller. A general AGV system essentially consists of vehicle peripheral on site component as well as stationary control system.

7.2 Components:

1) Sensor circuit

2) Processor

3) Driver

4) Actuators (Motors and wheels)

5) Vehicle

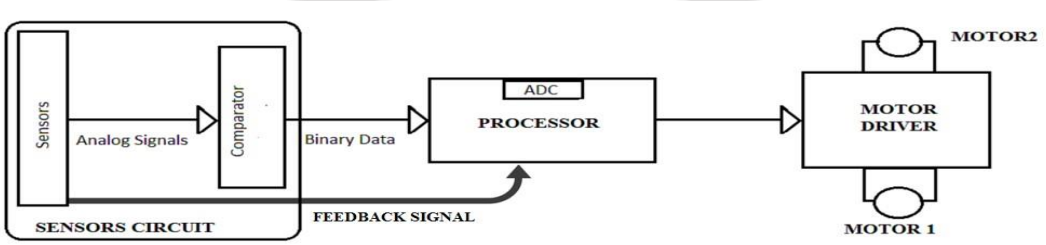

Fig. 7.1

(Components of Line Follower AGV)

A. Sensor Circuit:

The sensor circuit is a device which responds to some type of input from physical environment. In the line follower robot sensor circuit is responsible for detect the line segment or the path defined in the work floor. Robotics sensors are used in many implementations as object detection, path detection (line detection using colour variation.), etc. also it can be easily integrated to microcontroller based controlling systems which are also widely used. There are different types of sensor used in line follower AVG.

1) LDR sensor
2) Vision based sensor
3) Proximity sensor

LDR is a light dependent resistor which works by incident light on it. Its resistance varies according to change in the intensity of light. As the light falls on the LDR then it shows very high resistance ideally infinite and when there is not any light beam incident on it then it shows very less resistance ideally zero. That means if a voltage applied in the one terminal of the LDR then it gives zero voltage at another end if there is any light falls and vice versa. Deepak punithe (2013) designed the health care robot by using the LDR sensor.

Vision based sensor can operate by using the camera to record the features along the route allowing the AGV to replay the recorded to navigate the guided vehicle. The camera is the basic

requirement of the sensor because the movement of the line follower robot depends on the output of the camera. Resolution of the camera is not a problem in case of line tracking. Here only one camera is used which is placed in front of the robot at a tilt down position so as to capture the line track. The camera that is placed in front of the robot captures the track to be followed by the line follower robot.

A proximity sensor is a sensor able to detect the presence of nearby obstacles without any physical contact. This sensor is used as obstacle detector in the line follower robot. Proximity sensor is the infrared sensor, which use for detect the obstacle. IR sensors consist of two diodes that one of them sends ray and another one must receive it. If any obstacle comes between the Infrared transmitter and the Infrared receiver, then it gives the output.

B. Processer:

The processer is act as brain for line follower AGV. Usually the line follower robot works on a closed loop feedback algorithm where the feedback from the line sensor is used by the controller for correcting the path of the robot. The sensors are usually LED/LDR, LED/Photodiode or LED/Phototransistor pairs and the controller is an electronic circuit which executes the desired feedback algorithm. In general, the line follower robot senses the coloured path to navigate the vehicle. The input signal is coming from sensor array which send to the microcontroller to analyses the current position and give instruction to the driver according to pre-defined program. The task of the microcontroller here is to control the left and right motors according to the feedback signals from the left and right comparators so that the robot remains on the correct path. The processer is also responsible handling the different task and communication with other control system.

C. Driver:

Motor driver act like the current amplifier. It is use for controlling the current in the motor. The motor drive provides high current as the dc motor need when it receives low current in the circuit. For drive the motors a high value of the current is needed. L293D IC which can control the two dc motor simultaneously. It can rotate the motor in the forward and reverse direction. By using the motor driver, a line following robot can be move in clockwise and in anticlockwise directions. It

completely controls the movement of the dc motor that's why it has been called as motor driver.

D. Actuator:

The movement system is an important part of a robot. And its objective is how to move robot from one point to another one. This system has some details shown us how we should use motors and wheels. We use motors to convert electrical energy to the mechanical energy. There are a lot of kinds of motors and we must choice the best one that we need. Our choice is depended on the robot function, power and precision. Undoubtedly, one of the agents of success of our robot is to choose good motors. For the proper movement of the system two dc motors has been used in the circuit and a castor wheel is attached in the front side of that Line Following Robot Based Health Care Management System. Caster wheel enable the movement of the robot is easy in every direction. Two dc motors at the end side of the robot is controlled by the motor driver.

Chapter: 8

Result

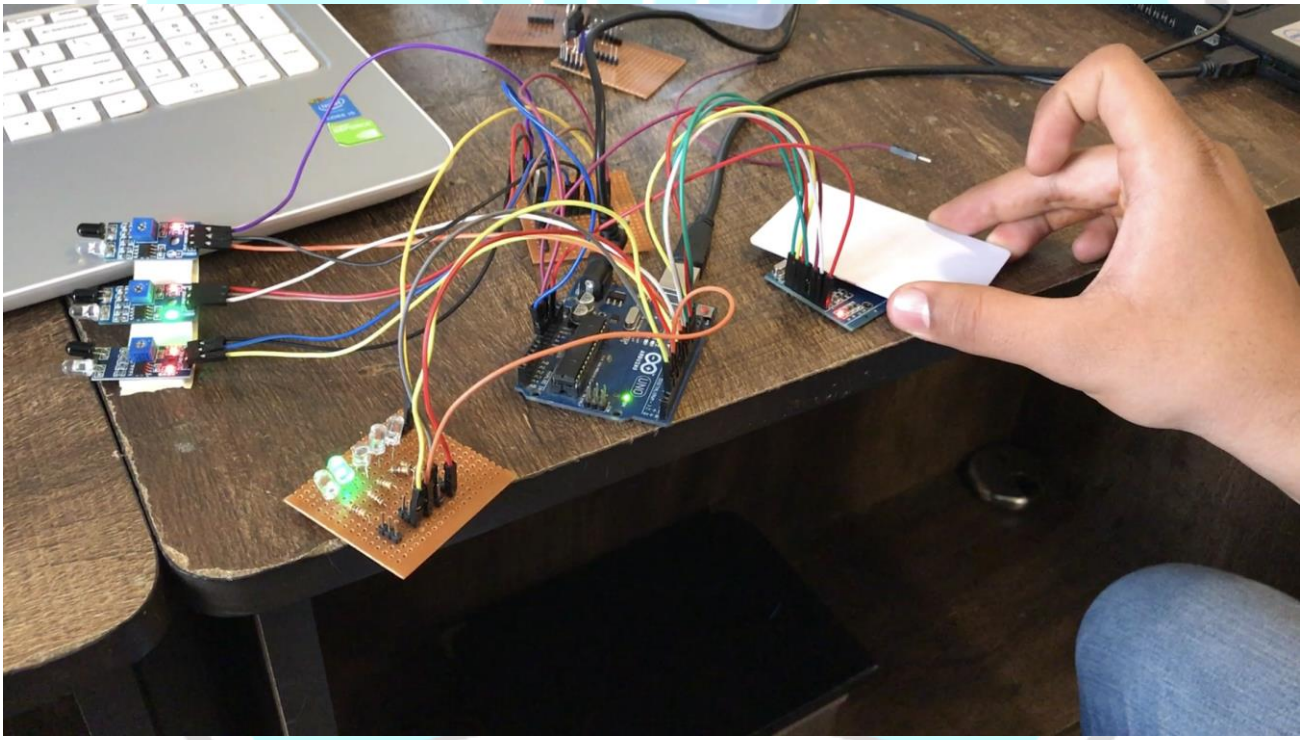

Fig. 8.1

(Output with RFID)

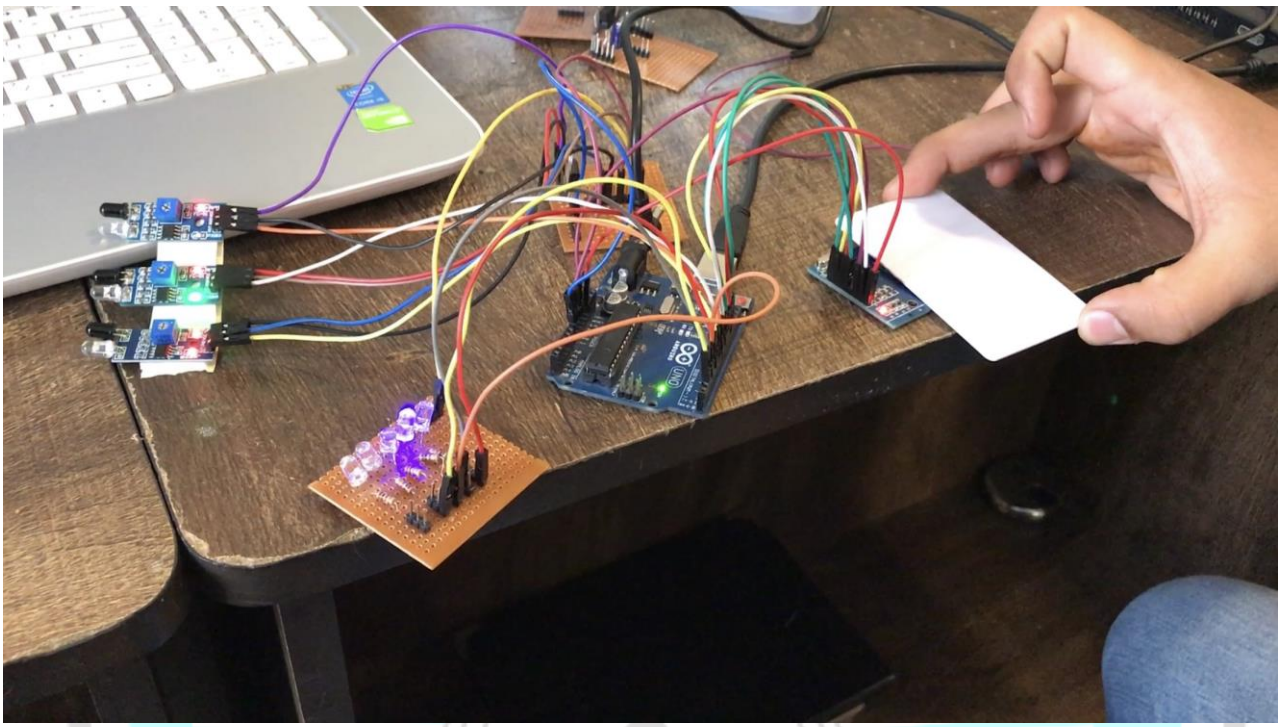

Fig. 8.2

(Output with IR Sensor)

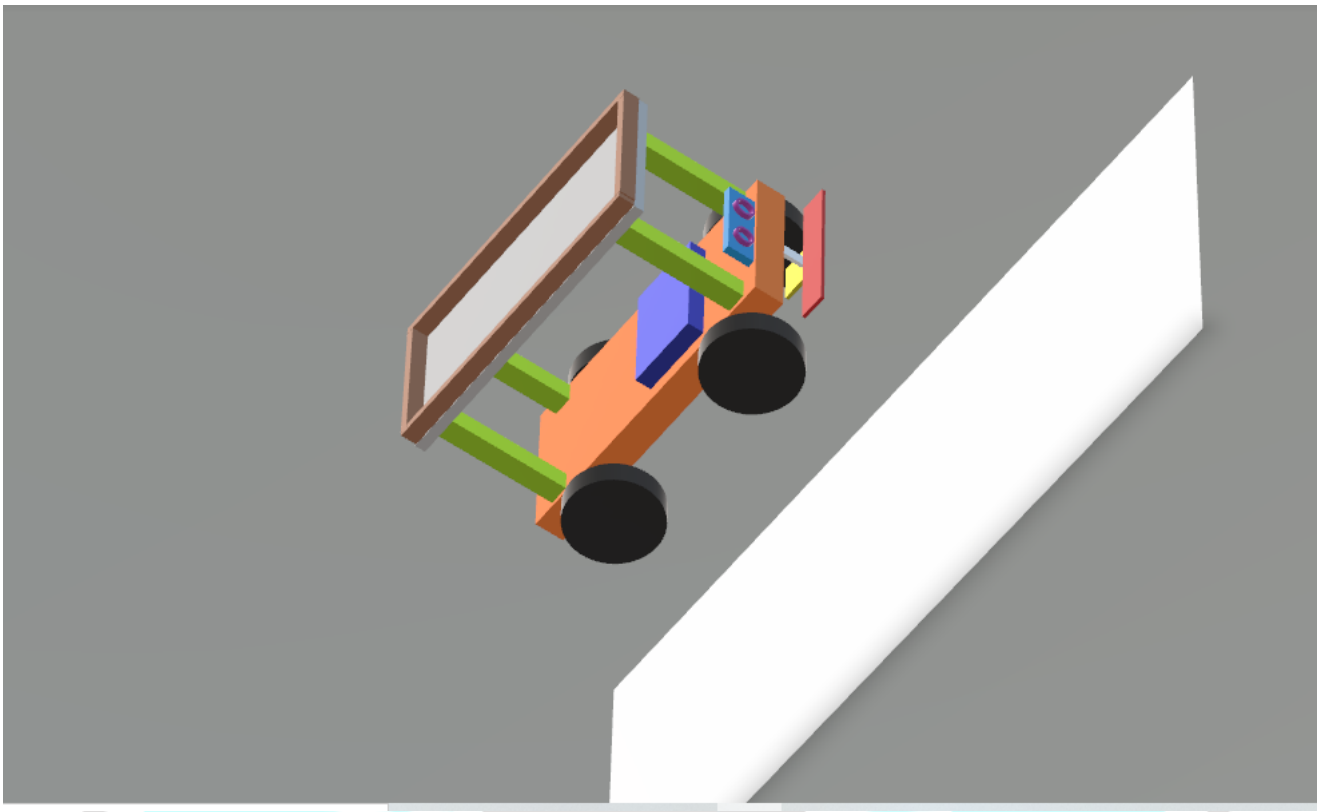

Fig. 8.3
(3D Image of Hardware)

Fig. 8.4

(Application 1)

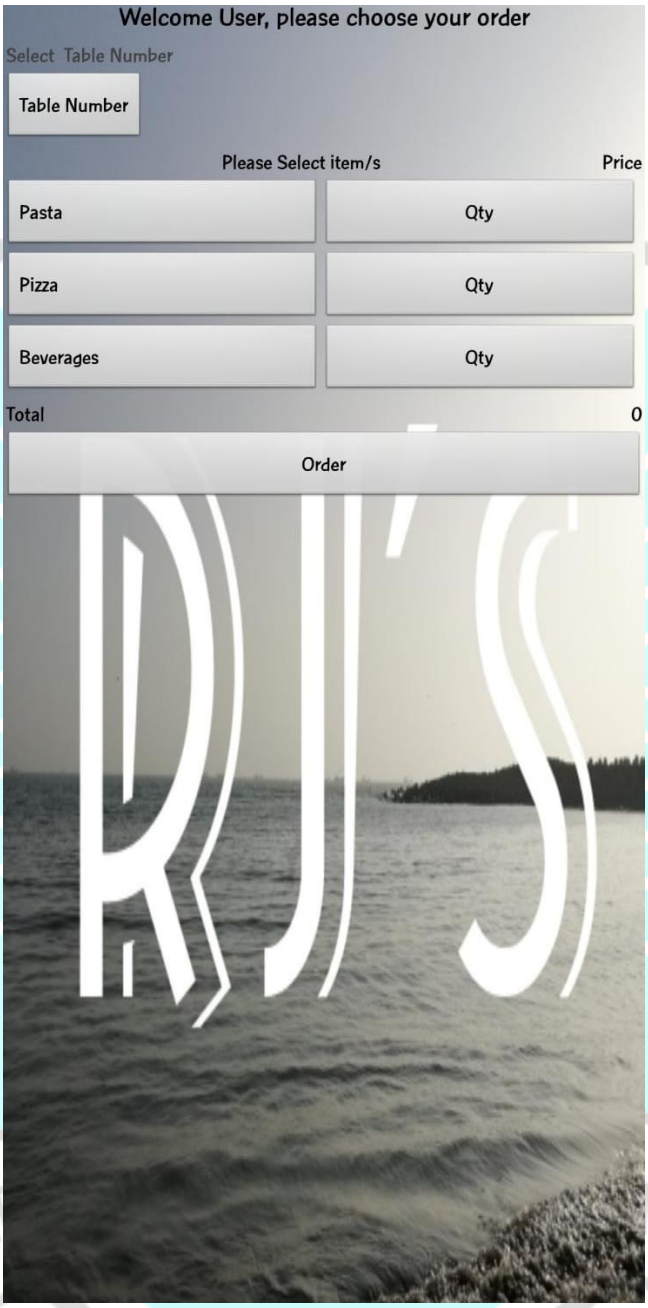

Fig. 8.5

(Application 2)

Fig. 8.6
(Application 3)

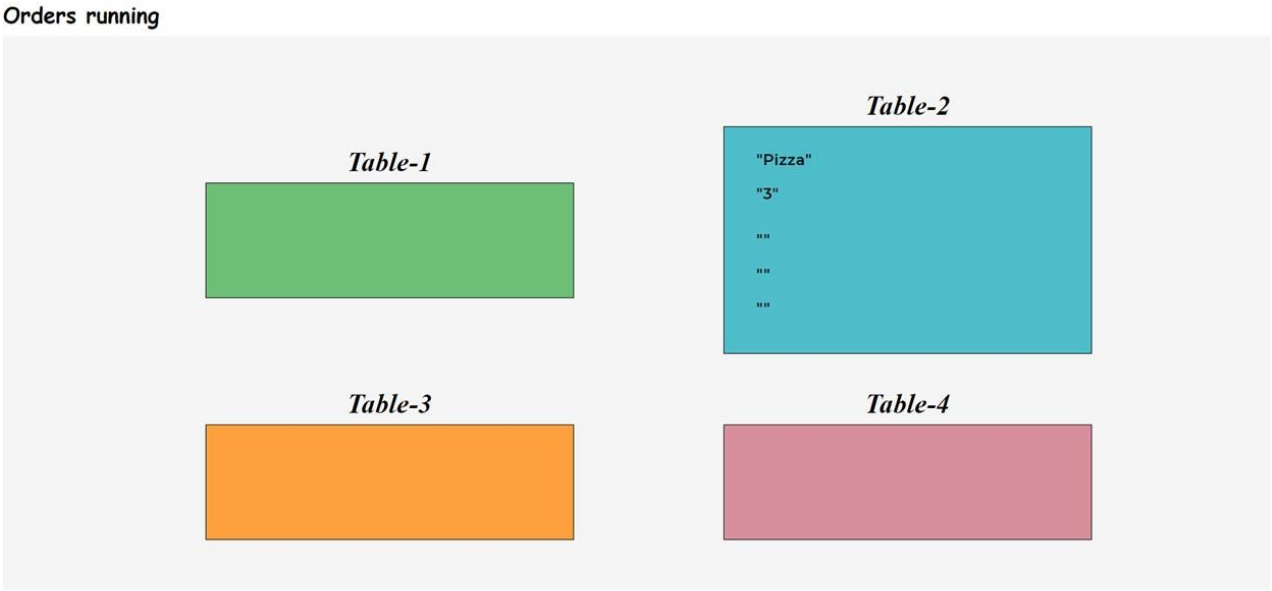

Fig. 8.7

(Webpage)

Chapter: 9

Review

First of all, we decided to make Renesas as our main microcontroller, we started communicating with the peripheral devices like Bluetooth, DC motor, Servo Motor, Hall Effect sensor, IR sensor. When we connected the Ultrasonic Sensor it was not working properly as per our requirement with Renesas. Also we tried connecting RFID it did not connect with Renesas and we were not getting the required output.

So we decided to change our microcontroller and we shifted to Arduino UNO. As we had more sensors to deal with UNO was not capable of connecting all the sensors and output devices. So we changed the controller to Arduino MEGA which has more I/O pins.

To develop the Android application, we started using the Android Studio but our guide suggested a website called MIT App Inventor which made the application part more convenient. First we were using the Bluetooth module to take orders from the users. We were not able to store the data from the users, so our guide suggested to replace Bluetooth with a database using Internet or NodeMCU.

So now we have Firebase as our database and we can see the orders running on a webpage designed by us using HTML, Java and CSS.

This is just one particular application of the Automated Guided vehicle in the restaurant field and can be AGV can be implemented in any prevailing industry and can get the desired work done.

Chapter: 10

Conclusion

From this project we have concluded that automation might seem easy but it is not. Robots still require human attention for their maintenance. To work efficiently we have to train the robots according to our need and they can work efficiently without wasting time and with no error.

We have designed a vehicle can take the food to the desired table and can take it back on just a click that can be monitored and can be manipulated according to our need. We have also used the cloud to make it real time and also used a database called Firebase to have on click reactions.

The system designed will be of low maintenance as compared to waged employees and eradicates the possibility of human error and also decreases the tediousness of the workers.

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