I-TROLLEY

Submitted in partial fulfillment of the requirements

of the degree of

Bachelor of Engineering in Electronics and Telecommunication

by

Rahul Paunikar (15104B0039)
Prashant Waghela (15104B0035)
Pritam Gadhari (15104B0011)
Brijesh Verma (15104B0009)

Supervisor (s):

Prof. Pooja Rane
Department of Electronics and Telecommunication Engineering

Vidyalankar Institute of Technology
Wadala (east), Mumbai- 400037

University of Mumbai

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CERTIFICATE

This is to certify that the project entitled

“I-Trolley”

is a bonafide work of

“Rahul Paunikar (15104B0039)
Prashant Waghela (15104B0035)
Pritam Gadhari (15104B0011)
Brijesh Verma (15104B0009)”

submitted to the University of Mumbai in partial fulfillment of the requirement for the award

of the degree of

“Undergraduate in Electronics and Telecommunication Engineering”.

Prof. Pooja Rane
(Supervisor/Guide)

Dr. Sanjay Thakur
(Head of Department)

Dr. Sunil A. Patekar
(Principal)

Project Report Approval for B. E.

This project report entitled "**I-Trolley"** by

1. Rahul Paunikar (15104B0039)
2. Prashant Waghela (15104B0035)
3. Pritam Gadhari (15104B0011)
4. Brijesh Verma (15104B0009)

is approved for the degree of **Bachelor of Engineering in Electronics and Telecommunication.**

Examiners

1.----------

2.----------

Date:

Place:

Declaration

We declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea in my submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Name	**Roll. No.**	**Signature**
Rahul Paunikar	15104B0039	
Prashant Waghela	15104B0035	
Pritam Gadhari	15104B0011	
Brijesh Verma	15104B0009	

Date:

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"Rahul Paunikar (15104B0039)
Prashant Waghela (15104B0035)
Pritam Gadhari (15104B0011)
Brijesh Verma (15104B0009)"

ABSTRACT

Purchasing and shopping at big malls is becoming daily activity in metro cities. There is a huge rush in such places during weekends and holidays. People purchase different items and put them in trolley. After completion of purchases, one needs to go to billing counter for payments. At the billing counter the cashier prepares the bill using bar code reader which is very time-consuming process and results in a long queue at the billing counter. I-Trolley is a product that aids the comfort, convenience and efficiency in everyday life. The key idea here is to assist a person in everyday shopping in terms of reduced time spent while purchasing a product. A trolley that will follow the customer and reduce the pain of pushing it.

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Introduction

1.1 Background and Motivation

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1.3 Problem Definition

1.4 Overview

INTRODUCTION

At present, many supermarkets still adopt traditional shopping mode and bar code scanning, which is a waste of manpower and material resources. Also, long wait in the queues for transactions and the tiresome pushing of shopping cart, all make customers suffer a lot and may cause customer volume go down. Consequently, there is a need to reduce queuing time for customers to check-out and to free people from the tedious job of pushing the shopping carts is an issue to tackle.

We are implementing an intelligent trolley that will keep a track of your budget and display it on an LCD display. I-Trolley will automatically generate a list of products in the trolley and this list will be sent to the mobile. It will also follow the user and the problem of pushing your own cart will be solved. I-Trolley is a robotic device that has to do with many applications in our day today life. Many works can be done efficiently through this device. Though we have planned to do the prototype for supermarket, this device can be used for many purposes such as military purpose, wheelchair for handicapped people, golf equipment carrying vehicle and etc. The main agenda is to minimize the human efforts and labour satisfying the need of the day today activities. Nowadays smart phones have become more powerful with advanced processors, large capacity of memory and more communication methods.

Three ultra-sonic sensors are fixed in the Chassis in front of the trolley, which detects the human motion once the connection is established between the user and the auto trolley. When it detects the motion of the user the trolley starts its movement. The Human Following Trolley is designed in such a way that if it detects an obstacle it finds an alternate way. If it couldn't find an alternate way it simply stops till a certain way is opened for the trolley to move. After the trolley is stopped and could not find its way then it is controlled by the user who has the remote control which manually gives an option to the individual to move the trolley in all four directions. Most of the human following robots are not cost effective as they are using 3D sensors and image processing. we planned to do the project in the cost-effective manner using three ultra-sonic sensors. We are implementing remote control to make our project more efficient. Using GPS Global Positioning System is problematic because there are many problems when building it. Globally GPS is accurate but when we consider a small area like super market or building, the error ratio will be high. Hence it is hard to exactly detect the co-ordinates of a system. Researches are going on the above scenario to exactly detect the position in small areas. Nowadays day to day new technologies are introduced to reduce the human efforts and save the human resources to larger extent. Scientists concerns are on making human physical labour easier by introducing automation technologies. So most of the researches are based on the aspect to make human day today labour easier. Our Human Following Trolley is one of the projects associated with reducing the human efforts and increase the overall efficiency.

1.1 Background and Motivation

At present the technology still involves continuous inputs from to carry big luggage/trolley from one place to another and the continuous paperwork required at such cargo shipping places and many another places the luggage are still carried by humans which can be a hectic work in near future where the time will be a major concern. Hence to overcome all such difficulties in future it will be beneficial to the engineers in near future by increasing the major operation of such a prototype. The major cost of such a prototype increases if a different method like image processing is used as the processing in such a scenario increases tremendously. Keeping the cost friendliness in mind, a different methodology has to be implemented.

1.2 Objective

To design a system that would display the list of products when the customer scans a product on the RFID Scanner. This will result in real time budgeting which will allow the customer to keep a track of their budget during his/her shopping. It will also detect the presence of angular displacement between the trolley's y-axis and the user's y-axis by taking the trolley's y-axis as reference. To make use of ultrasonic Transducer in efficiently finding the user's actual position with respect to trolley in an automatic manner.

1.2 Problem Definition

The problem faced by big shipping vehicles like trucks and ships requires continuous human intervention and monitoring. To avoid such a scenario the major problem is that the prototype should follow the human keeping a minimum distance so that the robot follows a particular human avoiding any other obstacles. The prototype should follow the human and turns according the movement of the human. Proper angular calculations and the speed of the human has to be calibrated finely so that the prototype follows the human with minimal errors. Such a prototype should be as pocket friendly as possible hence to check this box, a microcontroller with normal specifications should be used. At present, many supermarkets still adopt traditional shopping mode and bar code scanning, which is a waste of manpower and material resources. Also, long wait in the queues for transactions and the tiresome pushing of shopping cart, all make customers suffer a lot and may cause customer volume go down. Consequently, there is a need to reduce queuing time for customers to check-out. Hence the prototype will keep a track of your budget and display it on an LCD display and also will automatically generate a list of products in the trolley and this list will be sent to the mobile. Hence the problem of pushing your own cart and waiting in the long queue will be solved.

1.3 Overview

The prototype we are trying to design can be a major boosting factor in the upcoming industry. The prototype shall help various luggage and cargos to transport from one particular place to another without the intervention of any kind of human labor. It will also minimize the continues monitoring of goods inside the cargo carrying vehicles. The prototype is nearly the future of the world as the prototype can be used as a base for further progress.

Figure 1.1: Overview

Chapter 2

Literature Survey

2.1 Automatic Billing System using LI-FI Module

2.2 Person Following Shopping Cart Robot

2.3 Smart Shopping Cart

2.4 Robust low-cost passive UHF RFID based smart shopping trolley

LITERATURE SURVEY

As per the survey we found that maximum people are expected that shopping trolley should be functioning energy saving, pushing and pulling efforts should be less. Customer protection health is priority of supermarket. Mother and father of the child can't be together while shopping one have to take care of the children. It should be simple and pull the trolley while buying things. However, this very big problem for retailer of super market nowadays Following trolley is line following trolley which is designed is such a way that the sensor out will be given micro controller. This robot will sense the gadgets that are to be had at the gap of 7m-10m. in this they use particle filter out that reads the objects that far away from the reader distance, therefore this paper gives a way for tracking the objects which are round in an area.

2.1 Automatic Billing System using LI-FI Module

Zubin Thomas, Nikil Kumar and D. Jyothi Preshiya [1] proposed a model in which each and every product is having LIFI transmitter and it store the encoded data similar to the product id, cost of product and quantity. Here the mobile is integrated with LIFI receiver via OTG communication in the shopping cart. It can read the commodities' information when the LIFI transmitter holding goods are chosen by the customers, each information of the goods can be entered by using the mobile LIFI and when the product is kept into the trolley, which also contains the LIFI module, double check the product identity. After completing the purchase, the payment is processed in mobile itself via mobile banking system.

Large super markets have a great variety of goods and different supermarkets may have different distribution of commodity. Most of the customers find it difficult to stand in long queue for billing the purchased products. This causes waste of time and wrong billing for wrong customers. This project provides a great solution to all these problems. Most recently LIFI is new emerging technology in the trend. In this project data transfer is processed between products and the mobile phone. Each and every product is having LIFI transmitter and it store the encoded data similar to the product id, cost of product and quantity. Here the mobile is integrated with LIFI receiver via OTG communication in the shopping cart. It can read the commodities' information when the LIFI transmitter holding goods are chosen by the customers, each information of the goods can be entered by using the mobile LIFI and when the product is kept into the trolley, which also contains the LIFI module, double check the product identity. After completing the purchase, the payment is processed in mobile itself via mobile banking system. Finally, the cart section will verify the payment and purchase of product which will again cross check the products by the trolley module when we come out of the exit section of the shopping centre. If the product is mismatched at this stage it immediately alerts the owner. This technology is used in this project for finding out the information of the commodities.

Disadvantage:
It is not possible to equip LIFI module on each product and consume more power. It also requires line of sight.

2.2 Person Following Shopping Cart Robot

Soh Nishimura, Hiroshi Takemura, Hiroshi Mizoguchi [3] proposed a system which uses image processing for tracking the customer.

We introduce a development of attachable module for robotizing daily items. We aim at realization of robotizing daily items aiming at popularization in a robot's everyday life. We set the shopping cart as the concrete target. The aim of this study is to develop a porting system for large sized facilities, where the object item is autonomously carried by a person following ("after you") porting robot. The driving module and the sensor module are developed for development of a shopping cart robot. The outdoor running of the robot is attained by reforming a drive mechanism. Manual control is needed for the risk aversion at the time of a reckless run, or an operation test. The driving mechanism is used the compatible system which can change manual control and automatic control. This sensor has stereo camera and is used for person following system. The following system is the method of using together distance information and the information on a colour. Template matching using the HSV colour system as information on a colour is performed. We do the operation test about the driving mechanism, the compatible control system, and the person following operation, and performed the check of the robot of movement. By the experiment, while the shopping cart robot carried baggage, we check that it was possible to perform following operation.

Disadvantage:
Image processing requires high performance processor and high capacity battery. Therefore, it is not suitable for embedded system that has limited resource. Also, it is hard to distinguish between different users in one location.

2.3 Smart Shopping Cart

Akshay Kumar1, Abhinav Gupta1, S Balamurugan1, S Balaji1 and Marimuthu R1* 1School of Electrical Engineering, VIT University, Vellore have proposed a smart trolley system using RFID scanners.

This paper targeted to reduce the Queue at a billing counter in a shopping complex. The system does the same by displaying the total price of the product kept inside the cart. In this way the customer can directly pay the amount at the billing counter and leave with the commodities he/she has bought. It eliminates the traditional scanning of products at the counter and in turn speeds up the entire process of shopping, also with this system the customer shall know the total amount to be paid and hence can accordingly plan his shopping only buying the essential commodities resulting in enhanced savings. Since the entire process of billing is automated it reduces the possibility of human error substantially. Also, the system has a feature to delete the scanned products to further optimize the shopping experience of the customer. The hardware for the test run is based on the Arduino platform and Xbee modules, as both are very

popular in small-scale research and wireless automation solution.

2.4 Robust low-cost passive UHF RFID based smart shopping trolley

Tharindu Athauda, Juan Carlos Lugo Marin, Jonathan Lee, Nemai Karmakar Department of Electrical and Computer Systems Engineering Monash University, Clayton, Victoria 3800, Australia

Retailers are often interested in low cost mechanisms to maintain stocks as well as for tracing products across the supply chain in an efficient and effective manner. In addition, shoplifting is another concern faced because of the lack of effectiveness in product tracing technique such as “barcode” used in retail super markets. “AmazonGo” a smart retail layout which was introduced by Amazon, to address above issues was found to be inefficient due to the over dependency of system based on historical purchased patterns of consumers. In this study, we propose a low-cost, robust, passive UHF RFID based shopping trolley system which allows tracing and processing shopping data in real time. The UHF antenna mounted shopping trolleys are defined “Smart Trolleys” while shopping items are tagged using UHF RFID tags with unique identification codes

Chapter 3

System Design

3.1 Hardware

3.1.1 Hardware Components

3.2 Software

System Design

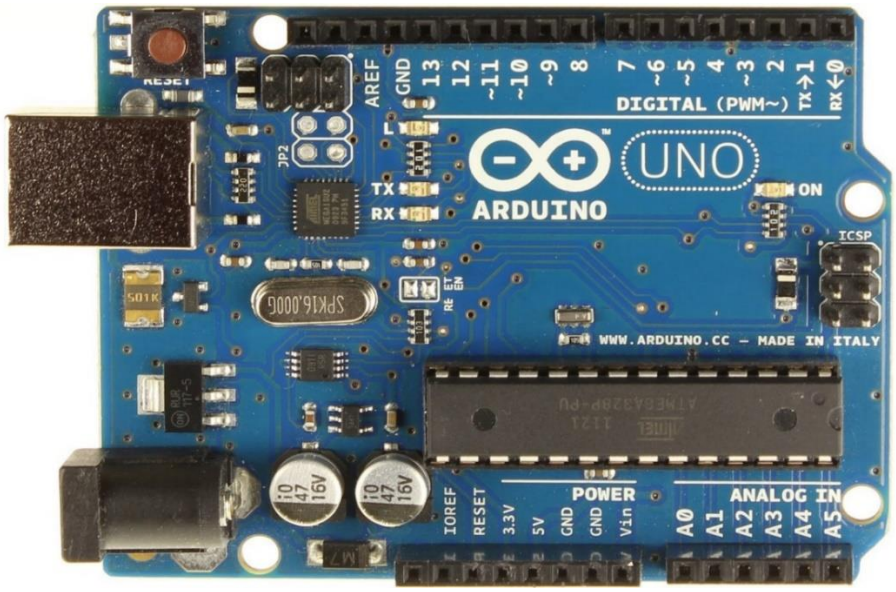
The system design of our system consists of various hardware components and the software is used to write the program for the autonomous system.

3.1 Hardware Design

The system consists of various hardware components like two dc motors, L298N Dual H Bridge Motor Controller to control the motors, 3 ultra-sonic Transducers, Buck Converter, LCD, MFRC522 Reader and Tags, Arduino Nano and Arduino Uno. We have fixed three ultrasonic sensors in front of the trolley, while other components are mounted on chassis. Two DC motors are attached with the two wheels. VCC and GND pins of Bluetooth module, motor controller and Ultra-sonic sensors are connected to the Arduino Uno with the help of Printed Circuit Board. 5V current is given to Arduino Uno through motor controller. The speed and the direction of the motors are controlled through the motor driver. Once the system is turned on, the ultra-sonic sensors are used to detect, measures and maintains a constant distance between the system and the user. Also, these Ultra-sonic sensors are used to detect the obstacles in front of the system and send those signals to the Arduino Uno. All three sensors are mounted in the front side of the trolley. The major Function of the front middle sensor is to indicate the distance between the trolley and user. The function of the other two sensors which is fixed left and right side of the front middle sensor is to detect when user moves left or right so that the trolley can move according to the user's direction.

Hardware Components

1. Arduino UNO:



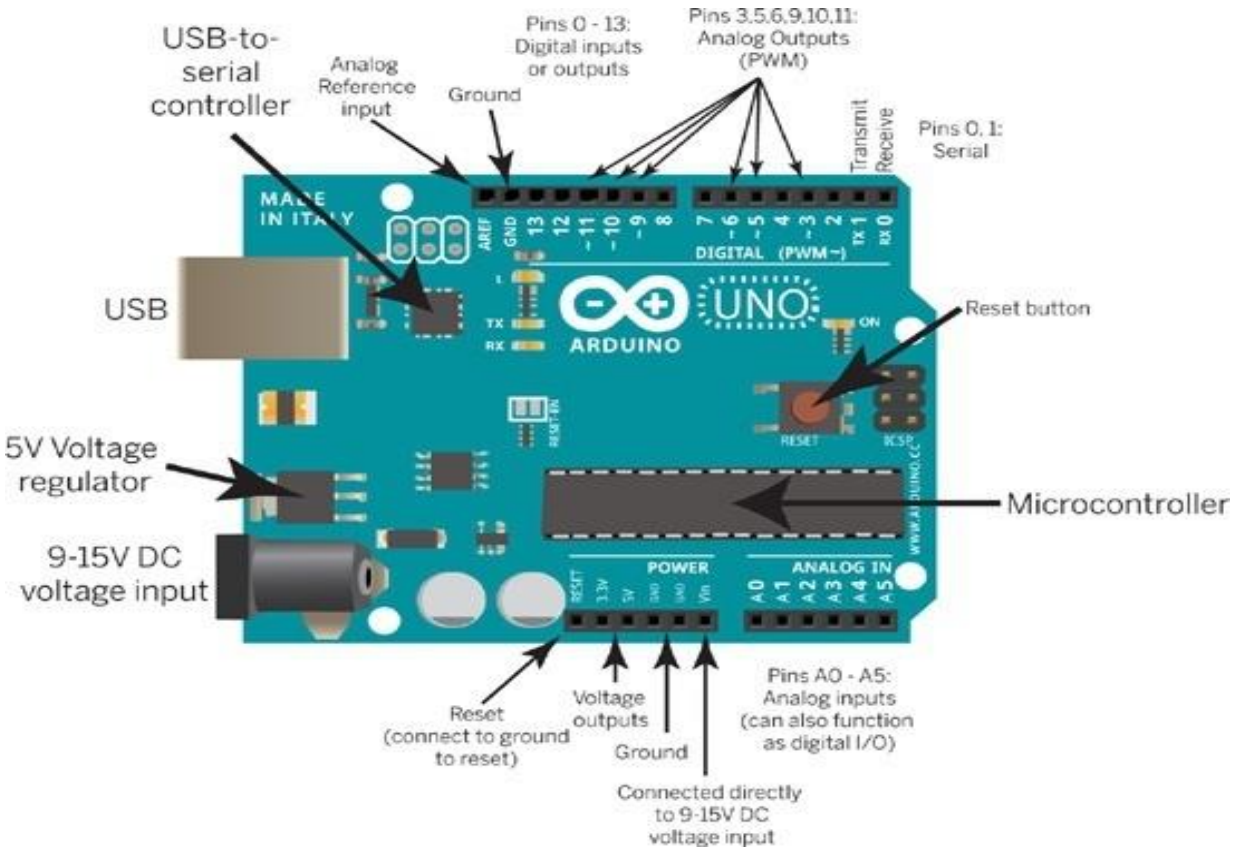
(a) Arduino Uno

Arduino is a single-board microcontroller meant to make the application more accessible which are interactive objects and its surroundings. The hardware features with an open-source hardware board designed around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM It is also capable of receiving and sending information over the internet with the help of various Arduino shields, which are discussed in this paper. Arduino uses a hardware known as the Arduino development board and software for developing the code known as the Arduino IDE (Integrated Development Environment). Built up with the 8-bit Atmel AVR microcontroller's that are manufactured by Atmel or a 32-bit Atmel ARM, these microcontrollers can be programmed easily using the C or C++ language in the Arduino IDE.

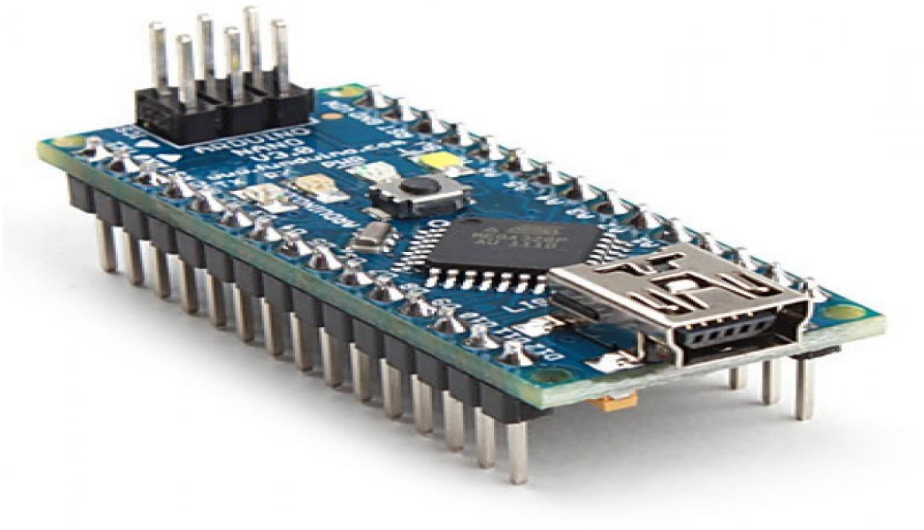
SPECIFICATIONS:

- 8-bit AVR microcontroller
- 32KB ISP flash memory with read-while-write capabilities
- 1024B EEPROM
- 2KB SRAM
- 6 analog inputs (10-bit resolution)
- 14 digital input/output (I/O) pins of which 6 can be used as pulse width modulated (PWM) outputs
- 40mA DC current per I/O pin
- 20 MHz max operating frequency

- 1.8-5.5-volt operating range
- UART
- Byte-oriented 2-wire serial interface (I²C)
- SPI serial port
- -40 to 85 (degree Celsius) operating temp. range
- Dimensions (excluding pins): 35.5mm x 8.6mm x3.33mm



2. Arduino NANO:



(b) Arduino Nano

Arduino Nano is a microcontroller board designed by Arduino.cc. The microcontroller used in the Arduino Nano is Atmega328, the same one as used in Arduino UNO. It has a wide range of applications and is a major microcontroller board because of its small size and flexibility. So, now let's have a look at its basic features:

Basic Features of Arduino Nano

Here are few of its basic features which you must know if you are thinking to work on this great microcontroller board:

- It has 22 input/output pins in total.
- 14 of these pins are digital pins.
- Arduino Nano has 8 analogue pins.
- It has 6 PWM pins among the digital pins.
- It has a crystal oscillator of 16MHz.
- It's operating voltage varies from 5V to 12V.
- It also supports different ways of communication, which are:
    - Serial Protocol.

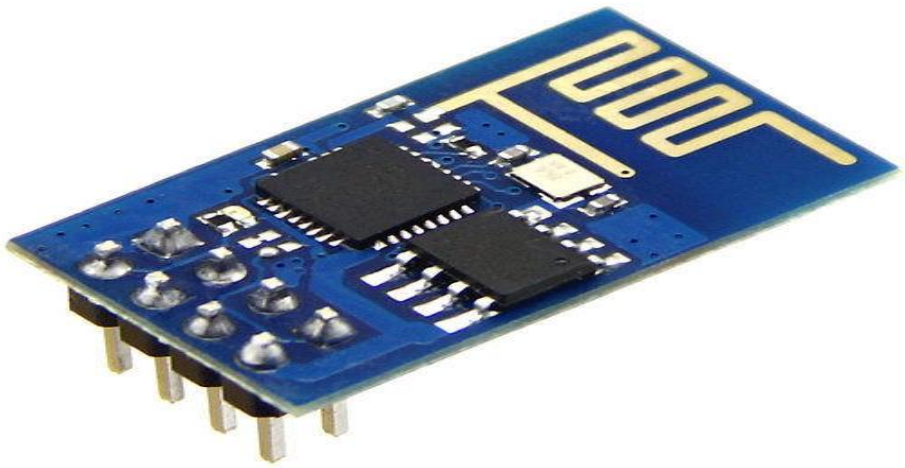
    - I2C Protocol.
    - SPI Protocol.
- It also has a mini USB Pin which is used to upload code.
- It also has a Reset button on it.

Memory in Arduino Nano

It has below memories embedded in it which are used for different purposes and are as follows:

- Flash memory of Arduino Nano is 32Kb.
- It has preinstalled bootloader on it, which takes a flash memory of 2kb.
- SRAM memory of this Microcontroller board is 8kb.
- It has an EEPROM memory of 1kb.

3. ESP 8266 WI-FI MODULE:



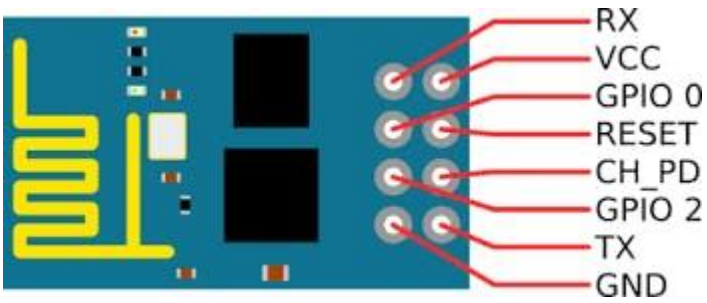
(c)ESP8266 Wi-Fi Module

The ESP8266 Wi-Fi Module is used to connect with any available internet hotspot and transfer sensor data to ThingSpeak Platform via Wi-Fi. The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to a Wi-Fi network.

The ESP8266 is capable of either hosting an application or off-loading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware. So, one can simply hook this up to an Arduino device. Here it uploads the monitoring data to the cloud. The module comes available in two models - ESP-01 and ESP-12. ESP-12 has 16 pins available for interfacing while ESP-01 has only 8 pins available for use.

ESP8266 is a 3V Wi-Fi module very popular for its Internet of Things applications. ESP 8266 maximum working Voltage is 3.6V and its very important to note.

ESP 8266 Pinout

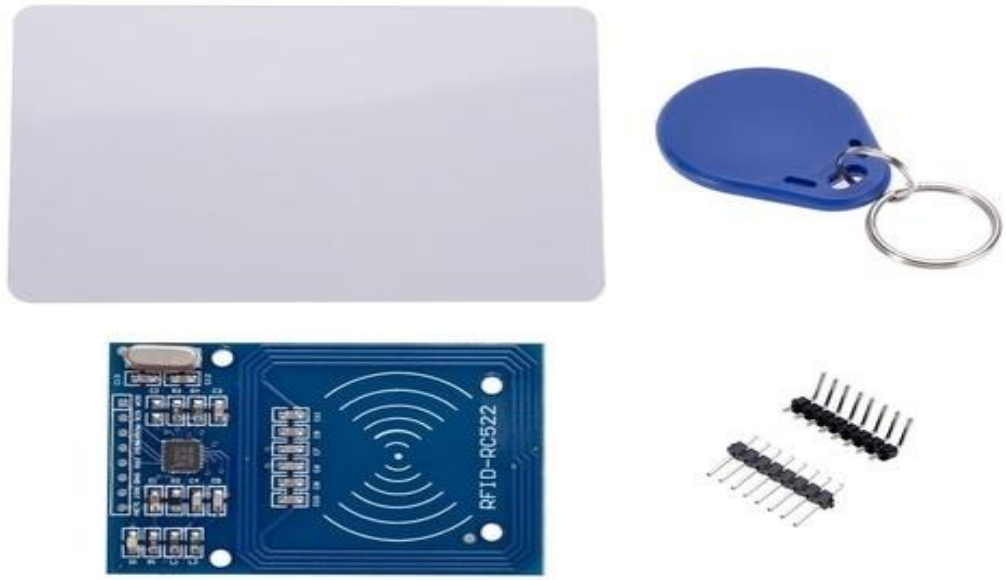


ESP8266 has 8 pins, namely:

- RX
- VCC
- GPIO 0
- RESET
- CH_PD
- GPIO 2
- TX
- GND

VCC and GND are powering pins. RX and TX are used to communicate.

4. MFRC522 READER AND TAGS:



(d) MFRC522 Reader and Tags

This low cost MFRC522 based RFID Reader Module is easy to use and can be used in a wide range of applications.

The MFRC522 is a highly integrated reader/writer IC for contactless communication at 13.56 MHz

Features:

- MFRC522 chip-based board
- Operating frequency: 13.56MHz
- Supply Voltage: 3.3V
- Current: 13-26mA
- Read Range: Approx. 3cm with supplied card and fob
- SPI Interface
- Max Data Transfer Rate: 10Mbit / s
- Dimensions: 60mm × 39mm

5. LCD 20x 4:

(e) LCD 20x 4

Interface Pin Function

Pin No.	Symbol	Description
1	V_{SS}	Ground
2	V_{DD}	Power supply for logic
3	V_O	Contrast Adjustment
4	RS	Data/ Instruction select signal
5	R/W	Read/Write select signal
6	E	Enable signal
7~14	DB0~DB7	Data bus line
15	A	Power supply for B/L +
16	K	Power supply for B/L -

6. ULTRASONIC TRANSDUCERS:

(f)Ultrasonic Transducers

Housing Material: Aluminum
Dimensions: 18mm Diameter x 9 mm Height
Frequency: 40 kHz
Sensitivity: =150mV
Max. Input Voltage: =140Vp-p
operating temperature: 30-70 °C.
Output: Analog sensor
Applications, among others, are: Distance Meter, Distance Sensor, Sound Detector, Robot Navigation, Send/Receive data

7. BUCK CONVERTER:

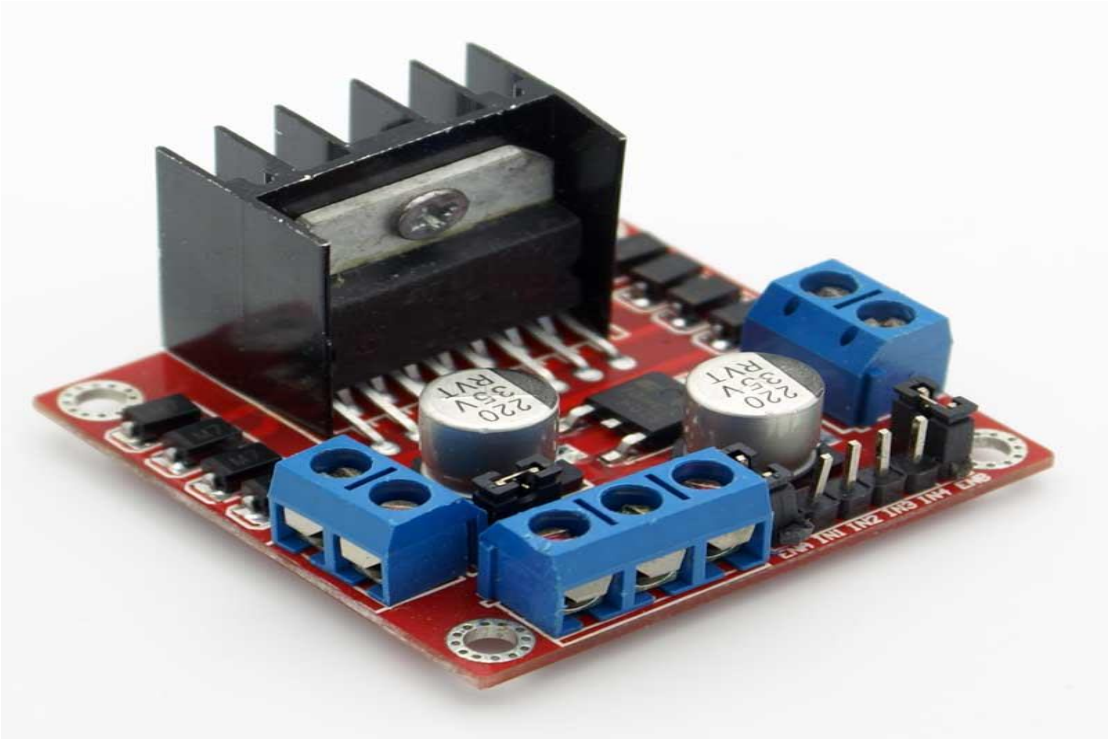
(g) Buck Converter

DC-DC Buck Converter Step Down Module LM2596 Power Supply is a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3 V, 5 V, 12 V, and an adjustable output version. The LM2596 series operates at a switching frequency of 150 kHz, thus allowing smaller sized filter components than what would be required with lower frequency switching regulators.

Specifications of DC-DC Buck Converter Step Down Module LM2596 Power Supply:

- Conversion efficiency: 92%(highest)
- Switching frequency: 150KHz
- Output ripple: 30mA9maximum)
- Load Regulation: ± 0.5%
- Voltage Regulation: ± 0.5%
- Dynamic Response speed: 5% 200uS
- Input voltage:4.75-35V
- Output voltage:1.25-26V(Adjustable)
- Output current: Rated current is 2A,maximum 3A(Additional heat sink is required)
- Conversion Efficiency: Up to 92% (output voltage higher, the higher the efficiency)
- Switching Frequency: 150KHz
- Rectifier: Non-Synchronous Rectification
- Module Properties: Non-isolated step-down module (buck)
- Short Circuit Protection: Current limiting, since the recovery
- Operating Temperature: Industrial grade (-40 to +85) (output power 10W or less)

8. Motor driver L298N:



(h)L298N Motor Driver

Specifications:

- Double H bridge Drive Chip: *L298N*
- Logical voltage: *5V Drive voltage: 5V-35V*
- Logical current: *0-36mA Drive current: 2A (MAX single bridge)*
- Max power: *25W*
- Dimensions: *43 x 43 x 26mm*
- Weight: *26g*

9. JOHNSON MOTORS:

(i) Johnson Motors

Specification:

- RPM: 300
- Torque: 5 kg-cm.to 7kg-cm
- Gearbox type: Metal gears.
- Length: without shaft 63 mm.
- Diameter: 28.5 mm.
- Gearbox diameter: 37 mm.
- Shaft diameter: 6 mm.
- Shaft length: 15 mm.
- Shaft Type: D Cut.
- Weight: 300 Gms.
- No load current: 100 mA.
- Full load current: 1.9 A.
- No load current (max): 800 mA.
- Full load current (max): 9.5A.
- Base motor RPM:18000
- Operating voltage:6-18 V
- Rated voltage:12 V

3.2 Software Design

The program code written for Arduino is known as a sketch. The software used for developing such sketches for an Arduino is commonly known as the Arduino IDE. This IDE contains the following parts in it:

- **Text editor:** This is where the simplified code can be written using a simplified version of C++ programming language.
- **Message area:** It displays error and also gives a feedback on saving and exporting the code.
- **Text:** The console displays text output by the Arduino environment including complete error messages and other information.

Console Toolbar: This toolbar contains various buttons like Verify, Upload, New, Open, Save and Serial Monitor. On the bottom right hand corner of the window there displays the Development Board and the Serial Port in use.

User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub *main()* into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program *avrdude* to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

Libraries used:

1. **SPI.h**: This library allows you to communicate with SPI devices, with the Arduino as the master device.
2. **MFRC522.h:** Read/Write a RFID Card or Tag using the ISO/IEC 14443A/MIFARE interface.
3. **LiquidCrystal.h**: This library allows an Arduino board to control LiquidCrystal displays (LCDs) based on the Hitachi HD44780 (or a compatible) chipset, which is found on most text-based LCDs. The library works with in either 4- or 8-bit mode (i.e. using 4 or 8 data lines in addition to the rs, enable, and, optionally, the rw control lines.
4. **SoftwareSerial.h:** The SoftwareSerial library has been developed to allow serial communication on other digital pins of the Arduino, using software to replicate the functionality (hence the name "SoftwareSerial"). It is possible to have multiple software serial ports with speeds up to 115200 bps. A parameter enables inverted signaling for devices which require that protocol.

Since there are 3 different independent subsystems thus there are 3 codes

1. Part 1: Smart billing using system RFID
2. Part 2: Human following trolley
3. Part 3: Transmitter section

PART 1 CODE:

```
#include <SPI.h>
#include <MFRC522.h>
#include <LiquidCrystal.h>
#include <SoftwareSerial.h>

#define SS_PIN 10
#define RST_PIN 9
#define BUZZER 2
#define Rbutton 5      // remove product
#define Bbutton 6       // bill
String ssid="Note9";                 // Wifi network SSID
String password ="prashant97";            // Wifi network password
boolean DEBUG = true;                //show additional data
int responseTime = 1000;            //communication timeout

LiquidCrystal lcd(14,15,16,17,18,19);         // declare pin on 20x4 LCD
SoftwareSerial wifiSerial(7,8);               // RX, TX of arduino
MFRC522 mfrc522(SS_PIN, RST_PIN);               // Create MFRC522 instance.

int getProductId(String );
int checkList(int );
String scanProduct();
void addProduct(String);
void removeProduct(String);
void displayBill();
void displayDatabase();

void StartServer();
void generateBill();
void sendToWeb(String d);
String sendToWifi(String command, const int timeout, boolean debug);
String addInHtmlTable(String NAME, int COST, int QTY);

struct products
{
  String tag;
  String pname;
  int pid;
  int cost;
  int quantity ;
  };
  struct products list[]={ {" 2C E0 15 AA","Pen",1,25,0} ,
                           {" 94 81 54 13", "Book",2,100,0},
                           {" E9 90 8D 48","soap",3,69,0} ,
                           {" 5B 55 6C AA","extra",4,20,0}
                          };

struct products current[10];
int item = 0;
int total=0;
String code4 = "<body><h1 align=center> SHOPPING BILL <h1><br><table
id=\"t01\"><tr><th>NAME</th><th>COST</th><th>QTY</th></tr>";
String code5 = "";


void setup()
{
  Serial.begin(9600);   // Initiate a serial communication
  while (!Serial) {
     Serial.println(".");  }           // wait for serial port to
connect.
```

```
  Serial.println("Serial started");

  wifiSerial.begin(9600);
  while (!wifiSerial) {
      Serial.println(".");    }         // wait for serial port to
connect.
  Serial.println("esp connected");

  SPI.begin();      // Initiate  SPI bus
  mfrc522.PCD_Init();   // Initiate MFRC522

  lcd.begin(20,4);
  lcd.clear();
  lcd.print("      I-TROLLEY   ");
  delay(1000);
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("NAME COST QTY TOTAL");

  pinMode(BUZZER, OUTPUT);
  noTone(BUZZER);
  pinMode(Rbutton,INPUT);
  pinMode(Bbutton,INPUT);
  digitalWrite(Rbutton,HIGH);
  digitalWrite(Bbutton,HIGH);

  displayDatabase();

}

void loop()
{ int i=0,j=-1,k,pid;

 if ( ! mfrc522.PICC_IsNewCardPresent())                // Look for new
cards
  {
    return;
  }

  if ( ! mfrc522.PICC_ReadCardSerial())                    // Select one of
the cards
  {
    return;
  }

  String content= "";
  byte letter;
  for (byte i = 0; i < mfrc522.uid.size; i++)
  {
     content.concat(String(mfrc522.uid.uidByte[i] < 0x10 ? " 0" : " "));
     content.concat(String(mfrc522.uid.uidByte[i], HEX));
  }
  Serial.println();
  content.toUpperCase();
  tone(BUZZER, 500);
  delay(300);
  noTone(BUZZER);

  if(digitalRead(Bbutton)==0)
    { Serial.println("Bbutton pressed");
      StartServer();
```

```
      generateBill();

      }

  if( (digitalRead(Rbutton)==0) && (content != "") )
  {
        removeProduct(content);
  }
  if( content != "")
    {
          addProduct(content);      }

    if(digitalRead(Bbutton)==0)
    { Serial.println("Bbutton pressed");
      StartServer();
      generateBill();
      }

   displayBill();

}                                        //  end of main loop

int getProductId(String tag)          // returns id of scanned product
{ int i;
  String temp;

  for(i=0;i<4;i++)
  {
    temp = list[i].tag;
         if(tag == temp)
         {
               return list[i].pid;}
          }
  }

 int checkList(int pid)       // check if scanned product is already in list
 {  int i;
    for(i=0; i<item ;i++)
    {
      if(  pid == current[i].pid )
         {
             return i;
           }
      }
    return -1;
  }

void addProduct(String content)
{ int pid,j;

     pid=getProductId(content);
     j=checkList(pid);

     if(j<0)
    {
      item++;
      current[item-1].pname = list[pid-1].pname;
      current[item-1].pid = list[pid-1].pid;
      current[item-1].cost = list[pid-1].cost;
      current[item-1].quantity = 1;
      total += list[pid-1].cost;
```

```
      }
      else
       {
         current[j].cost = current[j].cost + list[pid-1].cost ;
         current[j].quantity++ ;
         total += list[pid-1].cost;
         }

}

void removeProduct(String content)
{   int j,pid;
     pid=getProductId(content);
     j=checkList(pid);
     if(current[j].quantity > 0 )
     {
           current[j].cost = current[j].cost - list[pid-1].cost ;
           current[j].quantity-- ;
           total -= list[pid-1].cost;
     }
  }

void displayDatabase()
{
  Serial.println();
  Serial.println("**********PRODUCT DATABASE***************");
  int i;
  Serial.println("NAME      ID   COST");
  for(i=0; i<4; i++)
    {
       Serial.print(list[i].pname);
       Serial.print("   ");
        Serial.print(list[i].pid);
       Serial.print("   ");
       Serial.print(list[i].cost);
       Serial.println("   ");
      }
      Serial.println("****************************************");
 Serial.println("Put your card to the reader...");
  }

void displayBill()
{ int i;
   Serial.println("======================================");
  Serial.println("NAME        COST   QUANTITY");
  for(i=0; i<item; i++)
    {
     if(current[i].quantity > 0 ){
       Serial.print(current[i].pname);
       Serial.print("   ");
       lcd.setCursor(0,i+1);
       lcd.print(current[i].pname);
       Serial.print(current[i].cost);
       Serial.print("   ");
       lcd.setCursor(5,i+1);
       lcd.print(current[i].cost);
       Serial.println(current[i].quantity);
       lcd.setCursor(10,i+1);
       lcd.print(current[i].quantity);
      }}
      Serial.print("\ntotal = ");
```

```
      Serial.println(total);
      lcd.setCursor(14,1);
       lcd.print(total);
  }

void StartServer()
{   Serial.println("Start server");
  sendToWifi("AT",responseTime,DEBUG);
  sendToWifi("AT+CWMODE=1",responseTime,DEBUG);
 // configure as Station mode
  sendToWifi("AT+CWJAP=\""+ssid+"\",\""+password+"\"",responseTime,DEBUG);
 // connect to wifi
  delay(5000);
  sendToWifi("AT+CIFSR",responseTime,DEBUG);
 // get ip address
  sendToWifi("AT+CIPMUX=1",responseTime,DEBUG);
 // configure for single connections
  sendToWifi("AT+CIPSERVER=1,80",1000,DEBUG);
 // turn on server on port 80
  delay(500);
  Serial.println("Wifi connection is running Server Started!");
}

void generateBill()
{   Serial.println("...Bill Generation ...");

  String code4 = "<body><h1 align=center> SHOPPING BILL <h1><br><table
id=\"t01\"><tr><th>NAME</th><th>COST</th><th>QTY</th></tr>";
  String code5 = "";

  while(1){
  while(wifiSerial.available())
   {
      if(wifiSerial.find("0,CONNECT"))
      {   Serial.println("if ke andar");
         sendToWeb(code4);
         delay(400);
         for(int i=0 ; i<item ; i++)
        {  code5 = addInHtmlTable(current[i].pname, current[i].cost,
                          current[i].quantity);
           Serial.println(code5);
           code5 = "";
         }

         code5 += "<td colspan=\"3\"> <b>TOTAL :  Rs<b>";
         code5 += total;
         code5 +="</td></table></body></html>";
         sendToWeb(code5);
         delay(400);
         tone(BUZZER, 500);
         delay(600);
         noTone(BUZZER);
         delay(200);
         tone(BUZZER, 500);
         delay(300);
         noTone(BUZZER);
          delay(1000);
         while(1)
         {  //   WAIT.....................
         }
    }}}
```

```
 }

 void sendToWeb(String d)
{
   String cipSend = " AT+CIPSEND=0,";
   int len = d.length() + 4;
   cipSend +=len;
   //cipSend +="\r\n";
   sendToWifi(cipSend,1000,DEBUG);
   sendToWifi(d,1000,DEBUG);
}

String sendToWifi(String command, const int timeout, boolean debug)
{
   String response = "";
   command+="\r\n\r\n";
   wifiSerial.print(command);
   long int time = millis();
   while( (time+timeout) > millis())
    {
       while(wifiSerial.available())
        {
           char c = wifiSerial.read(); // read the next character.
           response+=c;
         }
     }

    if(debug)
     {
        Serial.print(response); //displays the esp response messages in
arduino Serial monitor
     }
    return response;
}

String addInHtmlTable(String NAME, int COST, int QTY)
{  String str = "<tr><td>";
   str += NAME;
   str += "</td><td>";
   str += COST;
   str += "</td><td>";
   str += QTY;
   str += "</td></tr>";
   return str;
  }
```

PART 2-A CODE:

This code is uploaded into the Arduino Nano and is used generates pulses of 40khz frequency through one of its digital ports.

```
void setup()
{
    Serial.begin(9600);
    pinMode(3,OUTPUT);
}

void loop()
{
   send("Hello World\n\n");
}

void send(String msg)
{
   byte ch;
   unsigned int pos = 0;
   unsigned int sz = msg.length();
   while(pos<sz)
   {
      ch = msg.charAt(pos);
      Serial.print((char)ch);
      tone(3,40000);
      delay(10);
      noTone(3);
      for(int i=0;i<8;i++)
      {
         boolean b;
         b = bitRead(ch,7-i);
         if(b)
         {
            tone(3,40000);
            delay(2);
         }
         else
         {
            tone(3,40000);
            delay(4);
         }
         noTone(3);
         delay(11);
      }
      pos++;
   }
}
```

PART 2-B CODE:

This code takes input from 3 ultrasonic receivers, which is used to determine the transmitters position and hence drive the motor accordingly.

```
#define enA 9
#define in1 4
#define in2 5
#define enB 10
#define in3 6
#define in4 7
int motorSpeedA = 0;
int motorSpeedB = 0;

int rx1;
int rx2;
int rx3;
int diff1;
int diff2;

void moveLeft();
void moveRight();
void moveStraight();

void setup() {
  Serial.begin(9600);

  pinMode(enA, OUTPUT);
  pinMode(enB, OUTPUT);
  pinMode(in1, OUTPUT);
  pinMode(in2, OUTPUT);
  pinMode(in3, OUTPUT);
  pinMode(in4, OUTPUT);

  digitalWrite(in1,LOW);
  digitalWrite(in2,HIGH);
  digitalWrite(in3,LOW);
  digitalWrite(in4,HIGH);
}

void loop() {

  rx1 = analogRead(A0);
  rx2 = analogRead(A1);
  rx3 = analogRead(A2);
  diff1 = rx1-rx2;
  diff2 = rx3-rx2;
  Serial.println(rx1);
  Serial.println(rx2);
  Serial.println( rx3);

if( abs(diff1 - diff2) < 50 )          //  Move Straight
    {
        moveStraight();
     }
else if((diff1 - diff2) > 50 )                  // Turn Left
    {
      moveRight();
    }
else                                // Turn Right
```

```
    {
       moveLeft();
     }

}

void moveStraight()
{
  Serial.println("Straight");
   motorSpeedA = 255;
   motorSpeedB = 255;
   analogWrite(enA, motorSpeedA); // Send PWM signal to motor A
   analogWrite(enB, motorSpeedB); // Send PWM signal to motor B

}

void moveLeft()
{
  Serial.println("Left");
  if( (abs(diff1) < 50) && (rx2 > rx1) )
      {  motorSpeedA = 200;
         motorSpeedB = 255;     }

   if( (abs(diff1) < 50) && (rx2 < rx1) )
      {  motorSpeedA = 150;
         motorSpeedB = 255;     }

   if( (abs(diff1) > 50) && (rx3 < 20 ) && (rx2 < 100) )
      {  motorSpeedA = 75;
         motorSpeedB = 255;     }
   analogWrite(enA, motorSpeedA); // Send PWM signal to motor A
   analogWrite(enB, motorSpeedB); // Send PWM signal to motor B
}

void moveRight()
{
  Serial.println("Right");
  if( (abs(diff2) < 50) && (rx2 > rx3) )
      {  motorSpeedA = 200;
         motorSpeedB = 255;     }

  if( (abs(diff2) < 50) && (rx2 < rx3) )
      {  motorSpeedA = 150;
         motorSpeedB = 255;     }

  if( (abs(diff2) > 50) && (rx1 < 20 ) && (rx2 < 100) )
      {  motorSpeedA = 75;
         motorSpeedB = 255;     }
  analogWrite(enA, motorSpeedA); // Send PWM signal to motor A
  analogWrite(enB, motorSpeedB); // Send PWM signal to motor B

}
```

Chapter 4

Working and results

4.1 Working and experimentation

4.1.1 Smart Billing System using RFID

4.1.2 Human Following using Ultrasonic Sensors

4.1.3 Transmitter Section

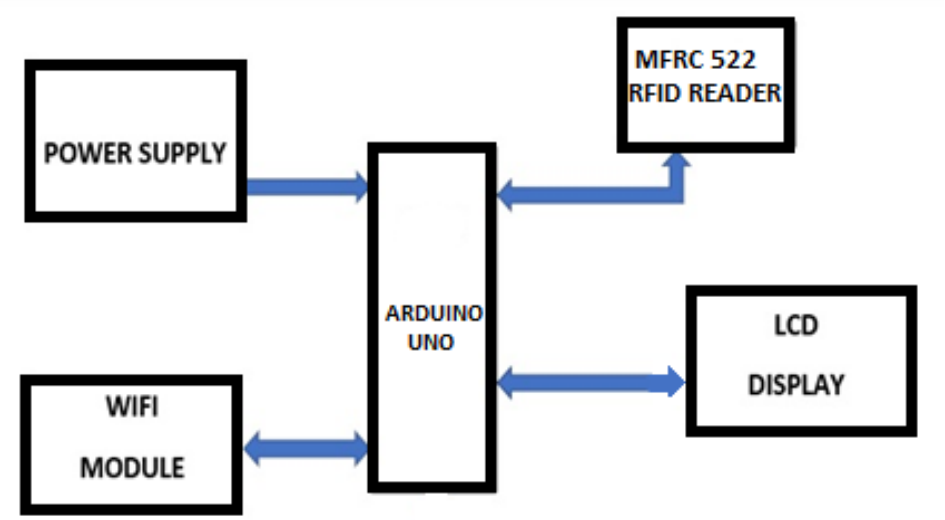
4.1.4 Receiver Section

4.2 Methodology

4.3 Results

Working and experimentation

4.1.1 Smart Billing System using RFID:



The above block diagram of part 1 consists of following blocks:

1. **Power supply:** The power is obtained from a 12 V battery which is shifted to 9 V using buck converter and then supplied to the Arduino which then in turn powers all other components.
2. **Arduino Uno:** It is the heart of the system which is based on Atmel's 16-bit Atmega 328 micro-controller. It takes input from RFID sensor, processes it and then gives desired results through output devices like LCD.
3. **RFID Reader:** MFRC 522 has been used as the RFID reader which works on the frequency of 13.52 MHz when a RFID tag Is brought close to it, it scans it and then sends the tag id to the micro-controller for further processing.
4. **Wi-Fi Module:** This block is responsible for sending the entire shopping bill data at the end of shopping from Arduino to the webpage on computer for final billing. It contains ESP8266 Wi-Fi module.
5. **LCD display:** A 20X4 LCD display is used for continuously displaying the shopping list data. As the customer shops and scan a product, the list gets updated every time.

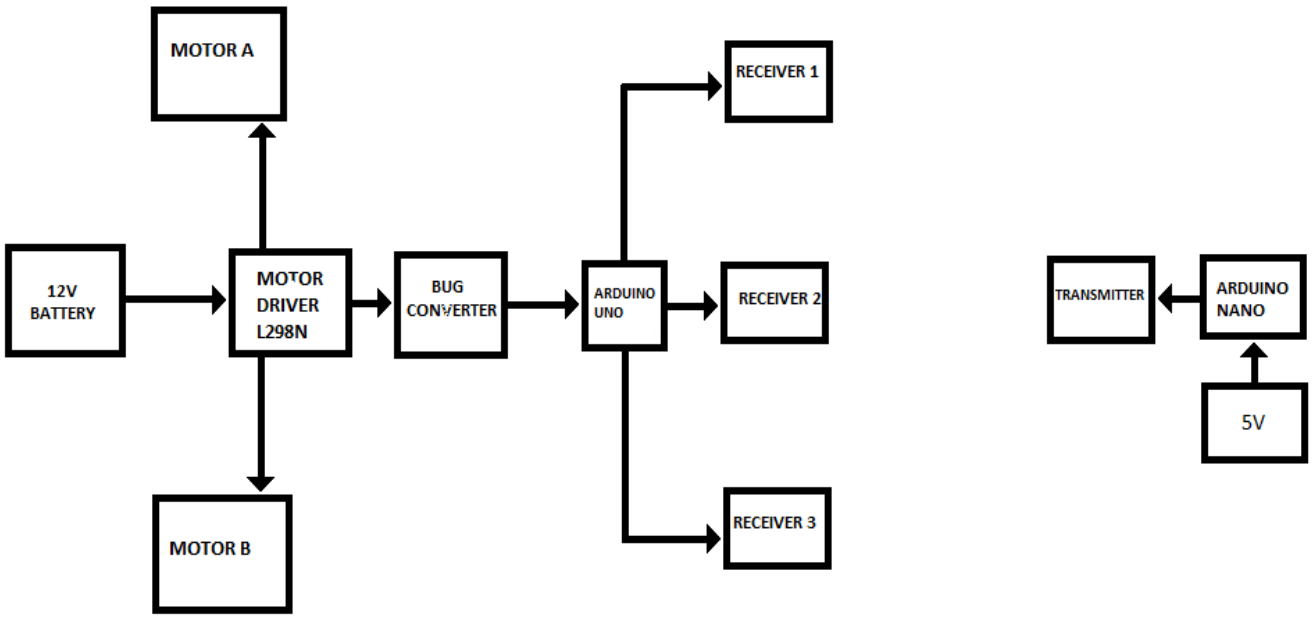
WORKING:

- The system on being turned shows I-trolley on the LCD display and it becomes ready to start scanning products. The customer can now scan any number of products and place it in the trolley.
- When the customer scans a particular product the arduino gets its tag id and it checks if the product is already present in the shopping list.
    1. If product is already present then its quantity gets incremented by 1.

2. If product is not present then it is added to the list.

- Thus, this way the customer can add products to the trolley and every item along with total bill is displayed on the LCD display continuously.
- If at some point the customer wants to remove any product then he can simply pull the switch labeled “Remove “, scan the product to get it removed from the list. After the removal every product the list on LCD display also gets updated instantly
- The customer can push back the switch in normal position to continue the shopping normally.
- Thus, in this way customer can shop be aware of the products he/she has and also kep track of the total bill.
- Finally, at the end of shopping the customer goes to the billing counter and pushes the switch labeled “GENERATE BILL”. After this the Wi-Fi module is started and it acts as a server
- Now when the computer requests for data by entering the static IP address of the Wi-Fi module using any browser such as google chrome or Firefox. The WIFI module sends the entire shopping bill data to the webpage.

4.1.2 Human Following using Ultrasonic Sensors



Working:

The proposed system consists of three ultrasonic receivers placed in front of the trolley and a single transmitter. The user will carry ultrasonic transmitter in his hands which signals the receivers due to which the trolley will see and follow the user. The user needs to carry this tiny, low power ultrasonic transmitter which the trolley should be able to "hear" and use the signal to navigate to the target, and follow it.

The transmitter transmits a 40kHz square wave signal towards the 3 receivers on the trolley. The receivers give readings in proportional to the distance from the transmitter. The receiver which receives maximum signal will decide the direction in which the trolley will move. The differential readings are obtained in order to get the best estimate of the user using the three receivers. The various cases involved in this are as follows:

Case1: The right receiver output increases, then the difference between the right and middle receiver is greater than the difference between left and middle, hence the trolley turns right.

Case2: The left receiver output increases, then the difference between the left and middle receiver is greater than the difference between right and middle, hence the trolley turns left.

Case1: If the difference between right and middle receiver is approximately same as that of the difference between left and middle receiver, then the trolley moves straight.

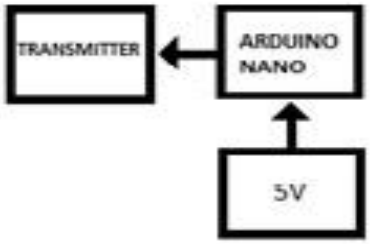
The main controller used is Arduino UNO which is used to store the values of the receivers and drive the motors according to the readings.

Motor driver L298N is used as a current amplifier whose function **is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor.**

The 12V battery is used to power the motors and the receiver circuit.

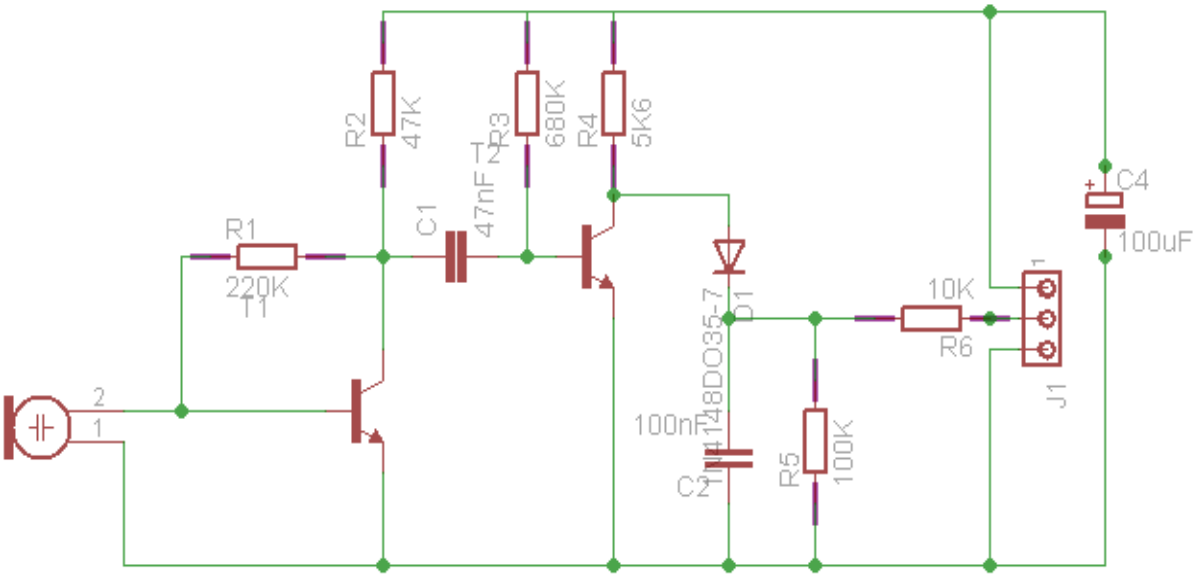
The DC to DC buck converter is used to step down the voltage from 12v to 9v in order to supply voltage to the Arduino UNO using the DC jack.

4.1.3 Transmitter Section:

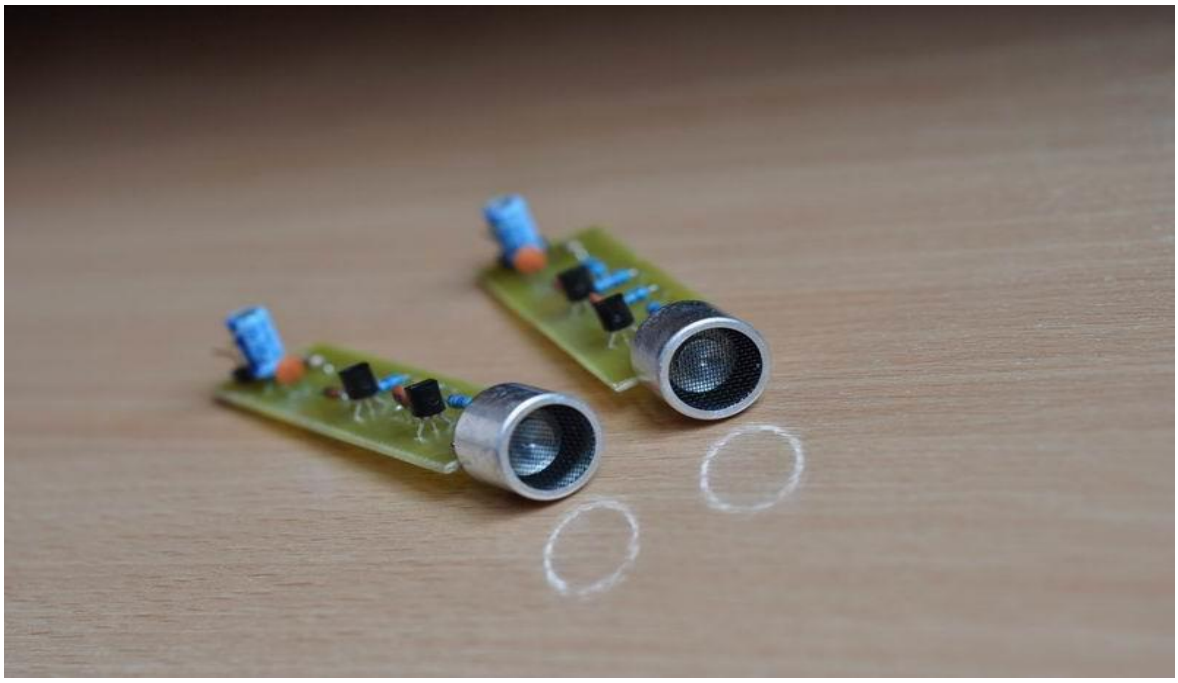


The transmitter section consists of a single ultrasonic transmitter which acts as a signaling beacon to the receivers placed on the trolley. The Arduino NANO is used with the ultrasonic transmitter in order to generate a 40 kHz square wave signal. The controller is powered using 5v supply. This assembly is carried by the user so that the trolley would follow the user.

4.1.4 Receiver Section



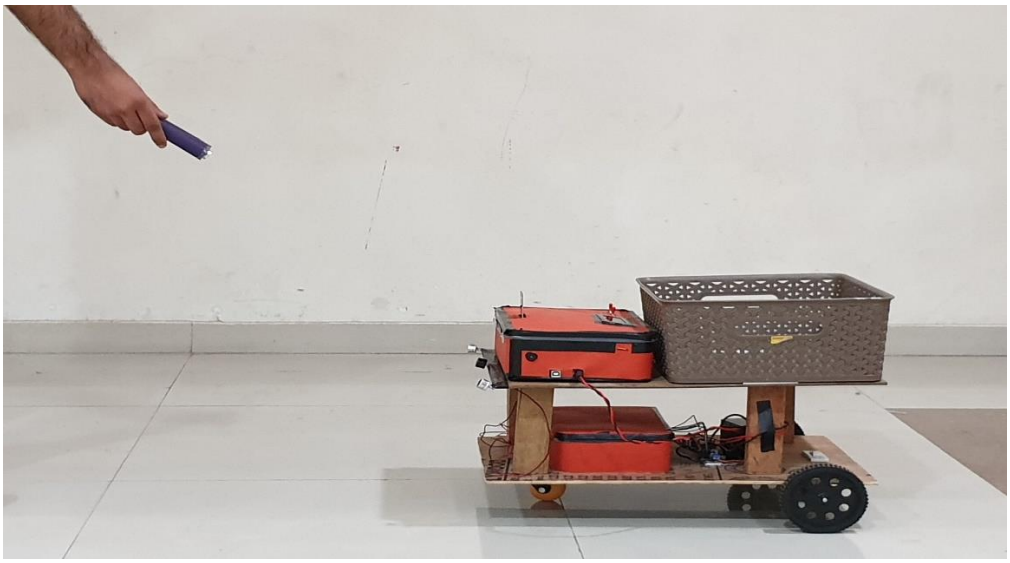
The figure shows the circuit diagram of an ultrasonic receiver.



Three receivers are placed at the front of the trolley in order to determine in which direction the trolley moves. The receivers receive the ultrasonic signal transmitted by the ultrasonic transmitter and based on the differential readings obtained the motion of the motors in controlled using Arduino.

Results

The project is developed with low cost, low power consumption. With our project costumers can enjoy shopping without pushing shopping trolley themselves. We are using sensors on the trolley which will track the human and will move at the maintained distance. The technology is day to day taking us into the new phase. Remarkable and unexpectable changes are taking place in the world via the advancement of the technologies. Our propose system can be further developed into an smart trolley where many functions like, weight measurement, bill calculation, number of items purchased calculation, credit card bill payment can be included. Indoor navigation can be implemented to find the accurate location of the user. This proposed system also can be implemented in wheel chair, bags, golf carrying equipment and so on. Hover board can be implemented with the trolley so that purchasing can be made easily. Since the trolley works in battery, battery indicator can be implemented to notify when the battery is low and the trolley must get to its initial position when the battery gets low.



Chapter 5

Evaluation and Conclusion

5.1 Cost Analysis
5.2 Conclusion
5.3 Future Scope
5.4 Timeline for semester 7
5.5 Timeline for semester 8

5.1 Cost Analysis

Components	Quantity	Cost
Arduino Uno	2	900
Arduino Nano	1	250
Mfrc522 RFID Reader and Tags	1-Reader, 3-Tags	250
LCD 20x4	1	400
ESP 8266 Wi-Fi Module	1	200
Ultrasonic Transducers	1-Tx, 3-Rx	375
Johnson Motors	2	900
Buck Converter	1	75
Motor Driver L298n	1	250
12v Battery	1	450
Toggle Switches	3	30
Bc548 Transistors	3	6
Diode 41480035	3	6
10k POT	1	4
Resistors: • 220k • 47k • 680k • 56k • 100k • 10k	3 Each	18
Capacitors: • 100uF • 47nF • 100nF	3 Each	18
TOTAL		4,132

5.2 Conclusions

In this paper we implemented a smart, efficient, productive, safer and low-cost RFID system in shopping malls for budget tracking at real time. The human following makes it even a better experience since the tiresome job of pushing your own trolley is eliminated. The system is capable to eliminate the hassle in the present shopping system. Our system is potent and capable of removing shopping woes in the current system and provides the best possible shopping experience. It is our belief that the model shopping system proposed will become one of the most promising technology in future generation.

5.3 Future Scope

The technology is day to day taking us into the new phase. Remarkable and unexpectable changes are taking place in the world via the advancement of the technologies. Our propose system can be further developed into a smart trolley where many functions like, weight measurement, bill calculation, number of items purchased calculation, credit card bill payment can be included. Indoor navigation can be implemented to find the accurate location of the user. This proposed system also can be implemented in wheel chair, bags, golf carrying equipment and so on. Hover board can be implemented with the trolley so that purchasing can be made easily. Since the trolley works in battery, battery indicator can be implemented to notify when the battery is low and the trolley must get to its initial position when the battery gets low.

I-trolley will automatically generate a list of products in the trolley and this list will be sent to the mobile. We can also provide online payment option by providing the payment link in the bill which is sent to our mobile handsets.

NAME	QTY	COST
PEN	4	50
BOOK	10	60
SOAP	4	25
TOTAL : ₹ 2550		

Various Payment Options:

5.4 Timeline Chart for Sem 7

Sr.No	Month	Week	Activity	Date
1	July	Week 1	Selection of project Domain	12/07/2018
2	July	Week 2	Interaction with Project Guide regarding project process and project ideas.	19/07/2018
3	July	Week 3	Choosing 3-4 topics on areas of interest and discussing ideas with the project guide.	26/07/2018
4	August	Week 4	Literature Survey and finding technical papers on each topic.	02/08/2018
5	August	Week 5	Project Review with Project Co-Ordinator.	09/08/2018
6	August	Week 6	Finalization of project topic.	18/08/2018
7	August	Week 7	Finalization of Topic and approval from the guide.	23/08/2018
8	August	Week 8	Departmental review	30/08/2018
9	September	Week 9	Project implementation details	06/09/2018
10	September	Week10	Resource budget and problems faced in the project.	12/09/2018
11	September	Week11	Institute level Project Review	20/09/2018
12	September	Week12	Literature Survey on I-Trolley	27/09/2018
13	October	Week13	Component Finalization	04/10/2018
14	October	Week14	Project synopsis report -soft copy format	11/10/2018
15	October	Week15	Verified project synopsis and diary and got its hardcopy.	18/10/2018
16	October	Week16	External Exam	25/10/2018

5.5 Timeline Chart for Sem 8

Sr.No	Month	Week	Activity	Date
1	January	Week 1	Implementation and testing' Preparation for mid sem review Status of project working during winter vacation	16/01/2019
2	January	Week 2	Project review-4 Clarify design concepts Discuss issues in implementation Project diary review	23/01/2019
3	January	Week 3	Implementation and testing track weekly progress	30/01/2019
4	February	Week 4	Implementation and testing track weekly progress	06/02/2019
5	February	Week 5	Implementation and testing track weekly progress	13/02/2019
6	February	Week 6	Demonstration of partial/full completion of executable code to guide Paper publication on results in reputed journal Attending project competitions	20/02/2019
7	February	Week 7	Project review-5 Scrutiny for Tantravihar and selection of best projects to e displayed Submission of scholarly term paper on implementation in IEEE format	27/02/2019
8	March	Week 8	Fine tuning project features	06/03/2019
9	March	Week 9	Preparation of project report(Black book) in given format V-Ideas photo session V-Ideas format from students	13/03/2019
10	March	Week10	Project review-6 on Final demo, mock viva and extent of tantravihar preparations	20/03/2019
11	March	Week11	Final preparation of tantravihar and other project competitions	27/03/2019
12	April	Week12	TANTRAVIHAR project exhibition	09/04/2019
13	April	Week13	Submission of project report (Black book) in given format External exams	25/04/2019

Chapter 6

Bibliography

Bibliography

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