# RFID BASED SMART TROLLEY FOR AUTOMATIC BILLING SYSTEM

***A Project report submitted in partial fulfillment of the requirements for the award of the degree of***

**BACHELOR OF ENGINEERING**

**IN**

**ELECTRONICS AND COMMUNICATION ENGINEERING**

***Submitted by***


K.Preethi (316126512083)

CH.Lokesh (316126512130)

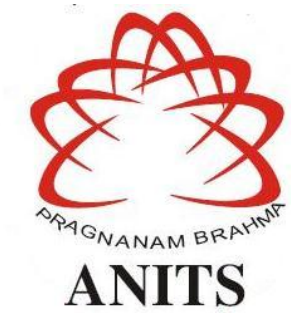
A.Sai Krishna (316126512122)

Afreen Firdaus (316126512123)


**Under the guidance of**

**Dr.G Manmadha Rao**

**M.E,Ph.D**





**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES

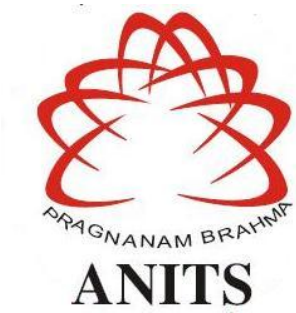
(*Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'A' Grade*)

Sangivalasa, Bheemili Mandal, Visakhapatnam Dist.(A.P)


2019-2020

**DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

**ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES**
**(*Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'A' Grade*)**
**Sangivalasa, Bheemili Mandal, Visakhapatnam Dist.(A.P)**




# CERTIFICATE

This is to certify that the project report entitled **"RFID BASED SAMRT TROLLEY FOR AUTOMATIC BILLING SYSTEM"** submitted by **K.Preethi (316126512083), CH.Lokesh (316126512130), A.Sai Krishna (316126512122), Afreen Firdaus (316126512123)** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Engineering** in **Electronics & Communication Engineering** of Andhra University, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

**Project Guide**
**Dr. G. Manmadha Rao**
M.E,Ph.D
Department of E.C.E
ANITS

**Head of the Department**
**Dr. V.Rajyalakshmi**
Department of E.C.E
ANITS

# ACKNOWLEDGEMENT

We would like to express our deep gratitude to our project guide **Dr. G. Manmadha Rao** Designation, Department of Electronics and Communication Engineering, ANITS, for his/her guidance with unsurpassed knowledge and immense encouragement. We are grateful to **Dr. V. Rajyalakshmi**, Head of the Department, Electronics and Communication Engineering, for providing us with the required facilities for the completion of the project work.

We are very much thankful to the **Principal and Management, ANITS, Sangivalasa,** for their encouragement and cooperation to carry out this work.

We express our thanks to all **teaching faculty** of Department of ECE, whose suggestions during reviews helped us in accomplishment of our project. We would like to thank **all non-teaching staff** of the Department of ECE, ANITS for providing great assistance in accomplishment of our project.

We would like to thank our parents, friends, and classmates for their encouragement throughout our project period. At last but not the least, we thank everyone for supporting us directly or indirectly in completing this project successfully.

**PROJECT STUDENTS**

**K.Preethi (316126512083),**
**CH.Lokesh(316126512130),**
**A.Sai Krishna(316126512122),**
**Afreen Firdaus(316126512123).**

# ABSTRACT

The modern technology has increased the standard of living for the humans. This resulted in large crowds at shopping malls. To handle the large crowd, we mustreduce the process of the billing time. This is done using smart shopping system based on RFID. Items that are put in a smart shopping cart are read one by one and the bill is generated and displayed. After the final bill is generated the customer pays the bill by using their Pre charged cards provided by the shopping mall. The aim is to reduce the time consumption needed for the billing system.

# CONTENTS

**LIST OF FIGURES:**

**LIST OF TABLES:**

# 1.INTRODUCTION

1.1Project objective:

In the present-day shopping system one of the difficultiesis to follow queue through the billing process which is time consuming. Hence this project aims to reduce the average time spent by the customer at the shopping mall by implementing automatic billing system using Rfid technology.

1.2Project outline:

The main aim of the project is to satisfy the customer andtoreduce the time spent on the billing process which is to complete the billing process in the trolley rather than waiting in a queue even for one or two products. The customers must add the products after a short scan in trolley and when the shopping is done the finalized amount will be displayed in the trolley. Customer could either pay their bill by their pre-recharged customer card provided by the shop. Finally, the whole information will be sent to central Pc of the shopping mall.

# LITERATURE SURVEY

As per our knowledge only few papers were found in the literature for the automated shopping trolley for supermarket using RFID. The automated shopping trolley for supermarket billing system implemented by Sainath (2014), exploited barcode for billing of products, where customer scans the product using barcode technology. The bill will be forwarded to the central billing system where customer will pay them by showing unique id. The limitation of barcode scanning requires line of sight for scanning and it should be fixed within its boundary. Cash register lines optimization system using RFID technology by Budic (2014), developed a system for shopping using RFID. The RFID is employed for scanning products and the information is stored in the database which could be paid online or in a central bill. It also uses web application to maintain entire shopping details. It requires maintenance of web application server. No necessary steps have been taken for the products that are accidentally dropped into the trolley by the customer. IOT based intelligent trolley for shopping mall by Dhavale Shraddha (2016), applied RFID technology for billing during purchase in shopping malls and IOT is used for bill management by means of ESP module. The payment details will be sent to the server by which central billing unit will deal with customer's payment. The ESP module will be working as a short distance Wi-Fi chip for wireless communication. But there is a drawback which includes constraints such as distance and interference. Server will be busy if customers are high and internet connectivity should be stable for finishing the process. Smart shopping trolley using RFID by KomalAmbekar (2015), implemented smart way of shopping trolley with RFID and ZigBee by which bill is generated by scan of products in the reader and bill transmitted to central billing department by which bill can be paid at the counter which is a major difficulty for the customer. Smart shopping cart with customer-oriented service by Hsin-Han Chiang (2016), accomplished a concept of automated shopping trolley with automated billing where they used face recognition for customer authentication. It is not a simple process as face recognition of customers during shopping hours will not be easy and accurate as malls can be crowded. Many errors are possible while using recognition for

authentication. Smart RFID based Interactive Kiosk Cart using wireless sensor node by Narayana Swamy (2016), applied RFID for automated shopping. They used dedicated website for billing maintenance and for user interaction. Every user with the unique id access the webserver for the bill payment and invoice information. Internet service is mandatory in this type of service. So the process may fail due to internet instability and server error problems may also occur due to high load. Shopping and automatic billing using RFID technology by Vinutha (2014), has an automatic billing with server end. This scans products by radio frequency identification and then the bill is generated at the server end which is then communicated to the customer. This requires server maintenance and internet connectivity both for the customer and shopkeeper. Smart shopping cart with automatic billing and Bluetooth proposed by Prateek Aryan (2014), is a process where billing is done in a trolley and transferred to the android mobile of the user via Bluetooth. Every customer can't be expected to have a smart phone and Bluetooth can have connectivity issues and range is less. Automated smart trolley with smart billing using Arduino by Suganya (2016), developed a model of automatic shopping with Arduino and an android application which again requires network to be connected always. Android operated mobiles may or may not be present with every customer. Network instability leads to delay in the billing. RFID enabled smart billing system by Vanitha Sheeba and Brindha Rajkumari (2015), did a concept model consists of RFID and ZigBee which transmits generated bill to the server and then the bill is collected by the worker in the bill counter by identifying customers. But this again will lead to queue for billing since only bill generation is alone automated by scanning using RFID. Our idea has a stable and simple billing process of making payment in the trolley itself. Since it avoids the requirement of Wi-Fi, ZigBee, ESP module and others which is used above. It can be paid using customer card or the ATM card. Above concepts doesn't ensure security and theft of products either intentionally or accidentally. We used door by which products cannot be dropped without scanning by the customer. We also have used separate IR sensor to avoid the accidental dropping of products. To make it more effective we used code logic which correlates the IR count and RF count in the microcontroller. For security we installed password authentication feature by which each customer possesses

unique card with unique password. Barcode technology is replaced by RFID in our system which gives fast and accurate scanning of products.

# CHAPTER 3

# RFID TECHNOLOGY

## 3.1Defining RFID:

RFID or Radio Frequency Identification System is a technology-based identification system which helps identifying objects just through the tags attached to them, without requiring any light of sight between the tags and the tag reader. All that is needed is radio communication between the tag and the reader.

Radio Frequency Identification (RFID) technology has been attracting considerable attention with the expectation of improved supply chain visibility for both suppliers and retailers. It will also improve the consumer shopping experience by making it more likely that the products they want to purchase are available.

As the technology keeps on changing day to day with the advancement of science new field of technology is being implemented in industry.

Previously before the introduction of Rfid technology, barcodes have been implemented.

### 3.1.1BARCODE HISTORY:

The barcode has been introduced in the year 1932 a small group of students from Harvard University, London first developed the concept of Automatic Product identification by passing a high intensity light through Morse code. Which gradually developed to Bar-coding system from the year,1948 soon the bar-coding technology opened for public use from 1967.

In 1967, the first the first bar coding was introduced to the retail world on a packet of Wrigley's Gum. Thirty-eight years later the number of applications bar code technology has exploded, going far beyond.

RFID advantages over barcodes.

1.No line of sight required for reading

2. Multiple items can be read with a single scan

3.Each tag can carry a lot of data (read/write)

4.Individual items identified and not just the category.

5.Passive tags have a virtually unlimited lifetime.

**RFID TECHNOLOGY**:


FIG1.1RFID TECHNOLOGY

**3.2RFID IMPLEMENTATION**:

The RFID chip has come a long way since its invention, see the journey below:

1940's - Radar technology was used to identify enemy and friendly aircrafts in WWII. Technically this was the first use of RFID
1948 - Scientist and inventor Harry Stockman creates RFID and is credited with the invention.
1963 - Inventor RF Harrington formulates new RFID ideas which include scattering data and information.
1977 - The first RFID transmitting license plate is created.
2000 - By this time over 1000 patents have been submitted using the RFID technology.
Experts believe that Rfid will be ubiquitous in 20 years, this may be hard to believe if you are not one of the business on the cutting edge of RFID technology but may have adopted this technology to reduce the cost and streamline operation.
Radio frequency identification (RFID) is a general term that is used to describe a system that transmits the identity (in the form of a unique serial number) of an object wirelessly, using radio waves.
RFID technologies are grouped under the more generic Automatic Identification (Auto ID) technologies.
The barcode labels that triggered a revolution in identification systems long time ago, are inadequate in an increasing number of cases. They are cheap but the stumbling block is their low storage capacity and the fact that they cannot be reprogrammed.
A feasible solution was putting the data on silicon chips. The ideal situation is contactless transfer of data between the data carrying device and its reader. The power required to operate the electronic data carrying device would also be transferred from the reader using contactless technology. These procedures give RFID its name.
One grand commercial vision for RFID is to change the way demand-supply chain moves. In the current almost stone-age scenario, manufacturer produces goods based on forecasts and hopes all of them will be consumed before the shelf life gets them. Good, if the market is consistent. Horrible, if a sudden surge makes the supply fall short and hence everyone in the chain miss on profits. Disastrous, if demand dies suddenly and losses are passed along the chain.
In a not so distant future, RFID enabled stores will monitor the consumption in real time. Shelf will signal the inventory when it needs more stuff and

inventory will pull supplies from the manufacturer based on its level of stock.
Simple concept, not-so-difficult implementation and revolutionary results in the pipeline. That's RFID, in short.

**3.3RFID Technology and Architecture:**

Before RFID can be understood completely, it is essential to understand how Radio Frequency communication occurs.
RF (Radio Frequency) communication occurs by the transference of data over electromagnetic waves. By generating a specific electromagnetic wave at the source, its effect can be noticed at the receiver far from the source, which then identifies it and thus the information.
In an RFID system, the RFID tag which contains the tagged data of the object generates a signal containing the respective information, which is read by the RFID reader, which then may pass this information to a processor for processing the obtained information for that application.
Thus, an RFID System can be visualized as the sum of the following three components:
1. RFID tag or transponder
2. RFID reader or transceiver
3. Data processing subsystem

An RFID tag is composed of an antenna, a wireless transducer and an encapsulating material. These tags can be either active or passive. While the active tags have on-chip power, passive tags use the power induced by the magnetic field of the RFID reader. Thus, passive tags are cheaper but with lower range (<10mts) and more sensitive to regulatory and environmental constraints, as compared to active tags.
An RFID reader consists of an antenna, transceiver and decoder, which sends periodic signals to inquire about any tag in vicinity. On receiving any signal from a tag, it passes on that information to the data processor.
The data processing subsystem provides the means of processing and storing the data.

**3.4RFID Standards**

Standards are critical in RFID. Be it payment systems or tracking goods in open supply chains. A great deal of work has been going on to develop standards for different RFID frequencies and applications.
RFID standards deal with the following: -

- **Air Interface Protocol** - The way tags and readers communicate
- **Data Content** - Organizing of data
- **Conformance** - Tests that products meet the standard
- **Applications** - How applications are used.

The way the world has gone about developing the standards is a bit complex. There are two major and somewhat conflicting organizations into the business - ISO and Auto-ID Centre (now handled by EPC Global). Without going too much into the conflict, we'll review the standards proposed by both these organizations.
Tags are required to be disposable (manufacturer may not get the tags back from the retailer to reuse it). Hence, the primary mission for any standard developer is to make the tags low cost. It should operate in UHF, as only UHF delivers read range needed for supply chain applications. And since the goods are needed to be tracked as they move across the globe, the standards must be open and globally accepted. There should also be an accompanying network architecture, which would enable anyone to look up information associated with a serial number stored on a tag. The network too needs to be based on open standards.
EPC standards for tags are the class 0 and class 1 tags:
**Class 1**: a simple, passive, read-only backscatter tag with one-time, field-programmable non-volatile memory.
**Class 0**: read-only tag that was programmed at the time the microchip was made.
Class 1 and Class 0 have a couple of shortcomings, in addition to the fact that they are not interoperable. One issue is that they are incompatible with ISO standards. The new EPC standard ~V Gen2 is designed to be fast tracked with ISO standards but for some disagreements over the 8-bit Application Family Identifier (AFI).
ISO has developed RFID standards for automatic identification and item management. This standard, known as the ISO 18000 series, covers the air interface protocol for systems likely to be used to track goods in the supply chain. They cover the major frequencies used in RFID systems around the world.

The seven parts are:

- 18000~V1: Generic parameters for air interfaces for globally accepted frequencies
- 18000~V2: Air interface for 135 KHz
- 18000~V3: Air interface for 13.56 MHz
- 18000~V4: Air interface for 2.45 GHz
- 18000~V5: Air interface for 5.8 GHz
- 18000~V6: Air interface for 860 MHz to 930 MHz
- 18000~V7: Air interface at 433.92 MHz

## 3.5RFID Applications:

There are two main area of applications, defined broadly as proximity (short range) and vicinity (long range).
Long range or vicinity applications can generally be described as track and trace applications, but the technology provides additional functionality and benefits for product authentication.
RFID enables greater automation of data collection process. Most companies spend considerable effort in knowing what's in their warehouse. RFID will help them dig deeper and much more easily, tracking to the detail of even each unit, long after it has left the factory or warehouse.
RFID allows all this data to be transferred securely. Companies use independent suppliers, data from each of them can be carried on tags and uploaded to the Company's central system.
Imagine the control that the Company will have on a product's life cycle. The creation of successes and defeats can be better understood. There have been numerous instances when companies had to recall the entire product due to a fault in a minor component. Imagine the costs involved in recalling a whole car for a mistake in the AC system! RFIDs can make such recalls much more focussed.
There would be better data about postproduction performance. A car could have individually tagged components. Data could be collected everywhere, accident sites, repair shops, even the garage. Even inside the factory, tags could enable faster and focussed fault tracing.

The Just in Time (JIT) practice followed by many companies, where components are used when they are delivered and delivered just before being needed, can lead to out of stock situations. RFID will eliminate the problem. The eventual aim of RFID in retail and manufacturing ~W eliminate the intermediary. A perfect supply chain would require no distribution center. Products would be delivered directly from the factory to the retail center. Some other areas where passive RFID has been applied in recent past are:

- Person Identification
- Food Production Control
- Vehicle Parking Monitoring
- Toxic Waste Monitoring
- Valuable Objects Insurance Identification
- Asset Management
- Access Control

Short range or proximity applications are typically access control applications. Some main areas are:

- Access control
- Mass transit ticketing

### 3.5.1RFID Security:

Through RFID in the near future, every single object will be connected to the Internet through a wireless address and unique identifier, was quipped by the global head of life science and consumer product industries at Sun Microsystems Inc.

> Certainly, feels impressive, and let me just help your imagination by setting a perfect scenario.
> You are sitting at your home watching television on a Sunday afternoon, and you know that your television is connected to the internet. Your couch, table even your dining set is connected to the internet. That is great for the automation!? Now, imagine your shirt, jeans, even your undergarments connected to the internet! It is only a

futuristic setup, but the privacy implications of RFID are equivalent in any application of RFID.

The basic privacy concerns associated with an RFID system is the ability of ubiquitous tracking of anybody without consent. And with RFID tags getting smaller and smaller, it is now even possible to hide tags in such a way that the consumer may be unaware of the presence of tags.
For example, the tags may be sewn up within garment, or moulded within plastic or rubber. To the extent that researchers have already developed tiny coded beads invisible to human eye that can be embedded in inks to tag currency and other documents, or added to substances like automobile paint, explosives, or other products that law enforcement officers or retailers have a strong interest in tracking. Researchers say that the technology should be ready for commercial use in 3-6 years.
In summary we can note the following ways in which RFIDs can be used to bypass personal privacy:

- By placing RFID tags hidden from eyes and using it for stealth tracking.
- Using the unique identifiers provided by RFID for profiling and identifying consumer pattern and behaviour.
- Using hidden readers for stealth tracking and getting personal information.

With all these privacy concerns, there is bound to be some effort to thwart such attempt at privacy and maintain the popularity of RFIDs. Researches at various places have yielded the following methods of avoiding above-mentioned attacks.

- RSA Blocker Tags: These tags are similar in size and appearance to RFID tags, helps in maintaining the privacy of consumer by SpammingT any reader that attempts to scan tags without the right authorization, thus confusing the reader to believe that there are many tags in its proximity.

- Kill Switches: Newer RFID tags are being shipped with a SkillSwitch, which will allow the RFID tags to be disabled. Thus, a consumer will be given an option of disabling the RFID tag before leaving the store, thus avoiding the possibility of stealth tracking and profiling.

**Consider a Couple of Situations:**

- You are in a mall buying a lot of things and now you have to wait in the queue for a long time and when your time comes, the person at the counter checks each item for its barcode, scans it and then the computer processes it slowly. Overall, it's a quiettime-consuming job both for you and the person at the counter.
- You are supposed to make a database of the students in a school or college or employees of any organization, present at any day. Manually checking the id of each person, making a database, updating it is quite a consuming work to do.

So how about considering an alternative, by the virtue of which you can just pick up things from the mall, place your bag on the scanner and just pay the bill and leave. Also, in the educational institutions or Organizations where you can just assign an ID tag to each member, check their attendance on any particular day through the ID tag.
To achieve the above alternatives, the solution or the technology used is RFID.

## 3.6A Basic RFID System:

**3 Main Components of a RFID System**

- **A RFID tag:** It consists of a silicon microchip attached to a small antenna and mounted on a substrate and encapsulated in different materials like plastic or glass veil and with an adhesive on the back side to be attached to objects.

- **A reader:** It consists of a scanner with antennas to transmit and receive signals and is responsible for communication with the tag and receives the information from the tag.
- **A Processor or a Controller**: It can be a host computer with a Microprocessor or a microcontroller which receives the reader input and process the data.

### 3.6.1TYPES OF RFID TAGS:

**Passive Tags** – It is the cheaper version using no battery. The Tag uses radio energy transmitting from the reader. So, the Reader must be close to the tag to transfer energy to power the Tag. Since the tags have unique serial number, the reader can recognize them individually.
**Active Tags**– These have an on-board battery and periodically transmits ID signals to the reader.
**Battery Assisted Passive or BAP**– These Tags have small battery on board and will be activated in the presence of signals from the reader.
**Read only Tags** – These have a unique factory assigned serial number used as the key for the data base.
**Read/ Write Tags** – These can write object specific data give by the system user.
**Field programmable Tags**– These can write once but read many times. Black tags can be written with an electronic product code by the user.

### 3.7Operating Frequencies:

Different types of RFID systems operate at different radio frequency. Eachradio frequency has its own read distance, power requirements and performance. The choice of frequency depends on the application. Mostly four types of frequencies are used in RFID technology:
A. Low frequency (120-140 KHz) - Low frequency RFID tags operate in low frequency range. Low frequency tags are used for depositing and withdraw and controlling following with the assets.

B. High frequency (13.56 MHz) - High frequency RFID tags operate in high frequency range. HF tagsare useful for asset-tracking applications, contact-less credit cards and ID badges.
C. The ultra-high frequency (869 MHz-928 MHz)-UHF RFID tag operate in 869 MHz - 928MHz.UHFtags are used in supply chain management applications. tags offer the longer reading range and arecheaper to manufacture in bulk.
D. Microwave (2.4 GHz-2.5 GHz) - Microwave system offers higher read rate. Microwave tags areexpensive than UHF tags. Microwave tags are used in electronic toll applications.

## 3.8RFID NEAR FIELD AND FAR FIELD:

Near-field RFID Faraday's principle of magnetic induction is the basis of near-field coupling between a reader and tag. A reader passes a large alternating current through a reading coil, resulting in an alternating magnetic field in its locality. If you place a tag that incorporates a smaller coil in this field, an alternating voltage will appear across it. If this voltage is rectified and coupled to a capacitor, a reservoir of charge accumulates, which you can then use to power the tag chip. Tags that use near-field coupling send data back to the reader using load modulation. Because any current drawn from the tag coil will give rise to its own small magnetic field—which will oppose the reader's field—the reader coil can detect this as a small increase in current flowing through it. This current is proportional to the load applied to the tag's coil (hence load modulation). This is the same principle used in power transformers found in most homes today—although usually a transformer's primary and secondary coil are wound closely together to ensure efficient power transfer. However, as the magnetic field extends beyond the primary coil, a secondary coil can still acquire some of the energy at a distance, similar to a reader and a tag. Thus, if the tag's electronics applies a load to its own antenna coil and varies it over time, a signal can be encoded as tiny variations in the magnetic field strength representing the tag's ID. The reader can then recover this signal by monitoring the change in current through the reader coil. A variety of modulation encodings are possible depending on the number of ID bits required, the data transfer rate, and additional redundancy bits placed in the

code to remove errors resulting from noise in the communication channel. Near-field coupling is the most straightforward approach for implementing a passive RFID system. This is why it was the first approach taken and has resulted in many subsequent standards, such as ISO 15693 and 14443, and a variety of proprietary solutions. However, near-field communication has some physical limitations. The range for which we can use magnetic induction approximates to $c/2\pi f$, where c is a constant (the speed of light) and f is the frequency. Thus, as the frequency of operation increases, the distance over which near-field coupling can operate decreases. A further limitation is the energy available for induction as a function of distance from the reader coil. The magnetic field drops off at a factor of 1/r3, where r is the separation of the tag and reader, along a center line perpendicular to the coil's plane. So, as applications require more ID bits as well as discrimination between multiple tags in the same locality for a fixed read time, each tag requires a higher data rate and thus a higher operating frequency. These design pressures have led to new passive RFID design. Far-field RFID tags based on far-field emissions capture EM waves propagating from a dipole antenna attached to the reader. A smaller dipole antenna in the tag receives this energy as an alternating potential difference that appears across the arms of the dipole. A diode can rectify this potential and link it to a capacitor, which will result in an accumulation of energy in order to power its electronics. However, unlike the inductive designs, the tags are beyond the range of the reader's near field, and information can't be transmitted back to the reader using load modulation. The technique designers use for commercial far-field RFID tags is back scattering. If they design anantenna with precise dimensions, it can be tuned to a frequency and absorb most of the energy that reaches it at that frequency. However, if an impedance mismatch occurs at this frequency, the antenna will reflect some of the energy (as tiny waves) toward the reader, which can then detect the energy using a sensitive radio receiver. By changing the antenna's impedance over time, the tag can reflect more or less of the incoming signal in a pattern that encodes the tag's ID. In practice, you can detune a tag's antenna for this purpose by placing a transistor across its dipole and then turning it partially on and off. As a rough design guide, tags that use far-field principles operate at greater than 100 MHz typically in the ultra-high-frequency (UHF) band (such as 2.45 GHz); below this frequency is the

domain of RFID based on near-field coupling. A far-field system's range is limited by the amount of energy that reaches the tag from the reader and by how sensitive the reader's radio receiver is to the reflected signal. The actual return signal is very small, because it's the result of two attenuations, each based on an inverse square law—the first attenuation occurs as EM waves radiate from the reader to the tag, and the second when reflected waves travel back from the tag to the reader. Thus, the returning energy is 1/r4 (again, r is the separation of the tag and reader). Fortunately, thanks to Moore's law and the shrinking feature size of semiconductor manufacturing, the energy required to power a tag at a given frequency continues to decrease (currently as low as a few microwatts). So, with modern semiconductors, we can design tags that can be read at increasingly greater distances than were possible a few years ago. Furthermore, inexpensive radio receivers have been developed with improved sensitivity so they can now detect signals, for a reasonable cost, with power levels on the order of –100 dBm in the 2.4-GHz band. A typical far-field reader can successfully interrogate tags 3 m away, and some RFID companies claim their products have read ranges of up to 6 m. EPCglobal's work was key to promoting the design of UHF tags , which has been the basis of RFID trials at both Walmart and Tesco . EPCglobal was originally the MIT Auto-ID Centre, a non-profit organization set up by the MIT Media Lab. The centre later divided into Auto-ID labs, still part of MIT, and EPCglobal, a commercial company. This company has defined an extensible range of tag standards, but its Class-1 Generation-1 96-bit tag is the one receiving the most attention of late. This tag can label over 50 quadrillion (50 1015) items, making it possible to uniquely label every manufactured item for the foreseeable future—not just using generic product codes. This isn't necessary for basic inventory control, but it has implications for tracing manufacturing faults and stolen goods and for detecting forgery. It also offers the more controversial post-sale marketing opportunities, enabling direct marketing based on prior purchases.

### 3.8.1RFID communication:

1.Host manages Reader(s) and issues Commands

2.Reader and tag communicate via RF signal
3.Carrier signal generated by the reader
4. Carrier signal sent out through the antennas
5.Carrier signal hits tag(s) Tag receives and modifies carrier signal – "sends back" modulated signal (Passive Backscatter – also referred to as "field disturbance device").
6.Antennas receive the modulated signal and send them to the Reader.
7.Reader decodes the data.
8.Results returned to the host application.

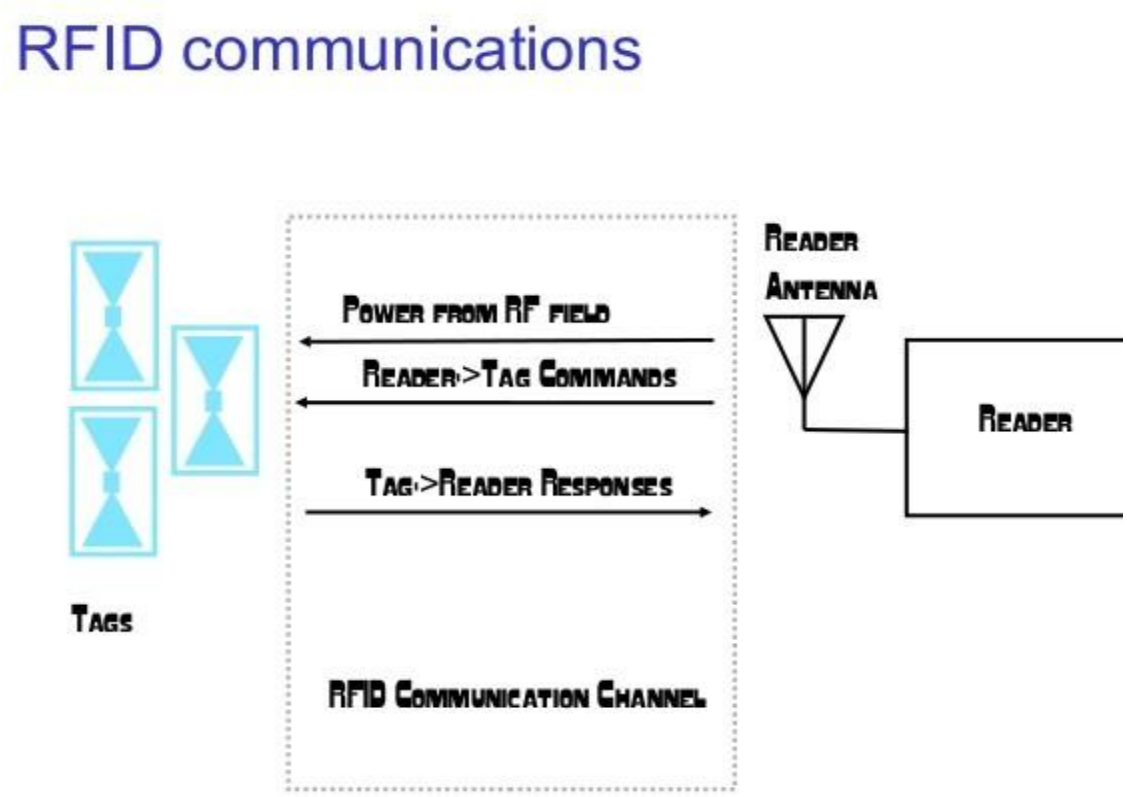



FIG: RFID COMMUNICATION

**3.8.2Multiple Tags:**

When multiple tags are in range of the reader: –

All the tags will be excited at the same time. Makes it very difficult to distinguish between the tags.

Collision avoidance mechanisms:
Probabilistic: – Tags return at random times
Deterministic: – Reader searches for specific tags

**3.8.3Tag Collision Problem**

Multiple tags simultaneously respond to query –
Results in collision at the reader
Several approaches

- Tree algorithm
- Memoryless protocol
- Contactless protocol
- I -code protocol

These are several approaches of algorithms and protocols used for the Tag collision problems.

## 3.9FUTURE SCOPE:

RFID technology uses radio waves to automatically identify people or objects. After sixty years of development RFID is being used in many fields. There are some problems needed to overcome before RFID technology becomes widespread in the world. One major problem is the high costs, the other is privacy issue. After avoiding problems, the RFID technology will be

a big help to human. Price of RFID tags are expected to decrease. RFID tags will only become cheaper and more powerful with improving technology and design experience. Some standards for RFID system are under development. Also, there is improvement in tag life expectancy and durability in past few years. The RFID technology brings new opportunities as well as challenges to the AIDC infrastructure. Although RFID suffers from many limitations but still Demand for RFID systems is increasing day by day. RFID tags can combine with sensors of different kinds. This would allow the tag to report not simply the same information over and over but identifying information along with current data picked up by sensors. Over times, the proportion of "scan-it-yourself" will increase. RFID technology does not replace barcode. This technology improves barcode by adding functions which existing barcode technology fail to achieve.

## ALGORITHM:

Step 1: Initially the cart is reset.

Step2:Then the Rfid TAG is read by the reader.if the tag is read at odd number of time then the item is added into the cart.

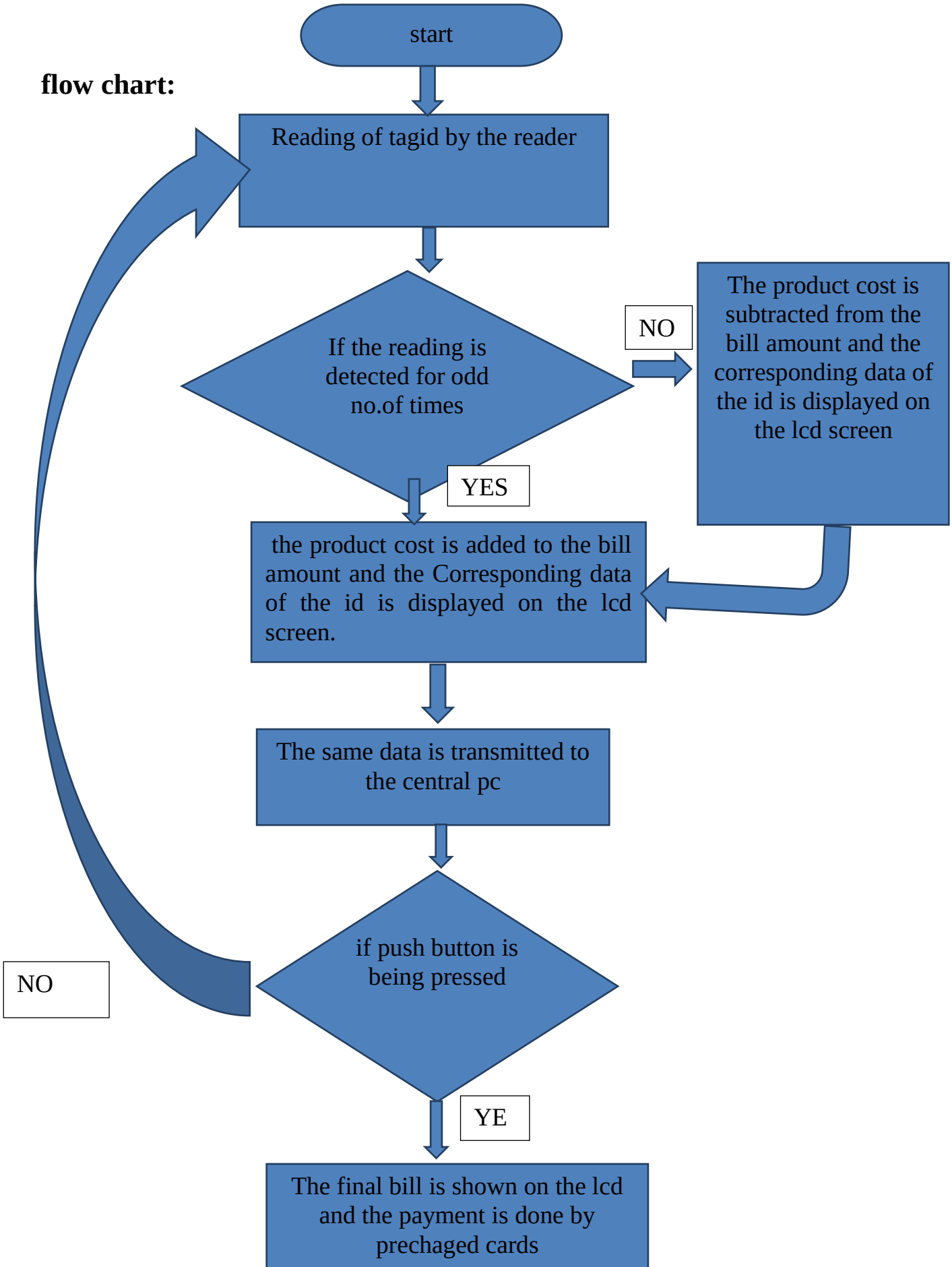
Step3:If the Rfid TAG is read at an even number of times it gets subtracted from the cart.

Step4:Again, after pressing the reset button the total billing amount is displayed on the LCD screen.

Step5: Then using the pre-charged cart the amount is debited form the cart.

Step6: After the final billing is done it is transmitted via HC-12 transmitter and it is observed at the billing section by the respective person.

**flow chart:**

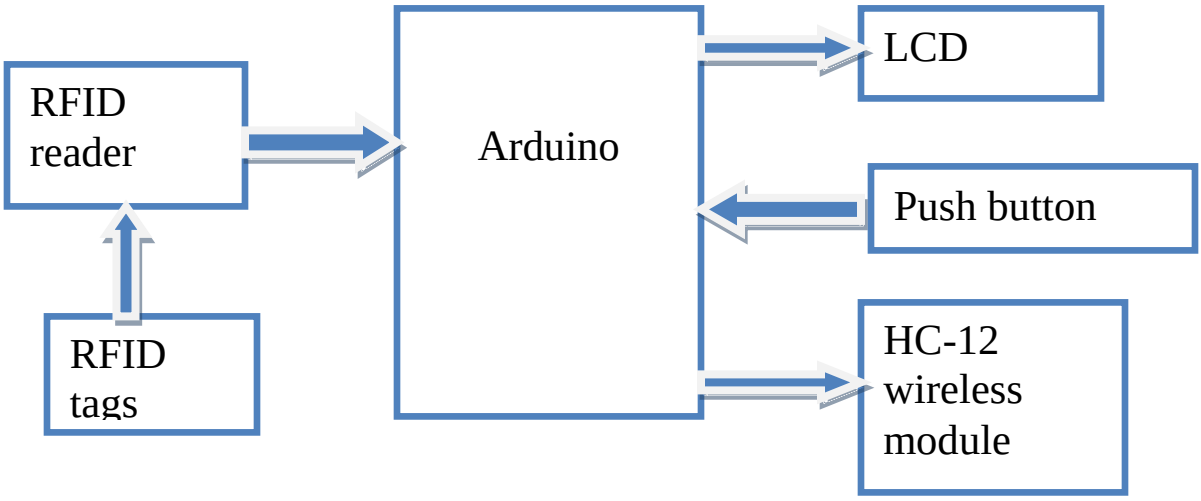

start
Reading of tagid by the reader
If the reading is detected for odd no.of times
NO
The product cost is subtracted from the bill amount and the corresponding data of the id is displayed on the lcd screen
YES
the product cost is added to the bill amount and the Corresponding data of the id is displayed on the lcd screen.
The same data is transmitted to the central pc
if push button is being pressed
NO
YE
The final bill is shown on the lcd and the payment is done by prechaged cards

# 6.METHODOLOGY

## DESCRIPTION:

An RFID tag (of frequency 125khz) is attached to every product in the mall and the reader (EM-18) is attached to the trolley. At the time of purchase, the tag attached to the product is scanned by the reader. Each tag has a unique EPC.Based on the EPC received by the Arduino, the information of the product is displayed on the LCD along with the updatedcost. This information is also sent to central PC with the help of HC-12 transmitter at the trolley and HC-12 receiver at the PC.If the customer wants to remove the added product, the product should be scanned again. Then the cost of the corresponding product will be deducted from the bill. The push button is provided at the trolley toindicate the end of the shopping. On pressing of push button, the final bill is displayed on the LCD and the payment through precharged card can be done. Recharged cards are unique RFID tags provided for each customer. These cards contain the information such as the customer identification number and the balance available in the card.by scanning prechargedcards,payment is done at the trolley itself.Finally,LCD shows the balance available in their card .This whole information is available on the serial monitor of central PC

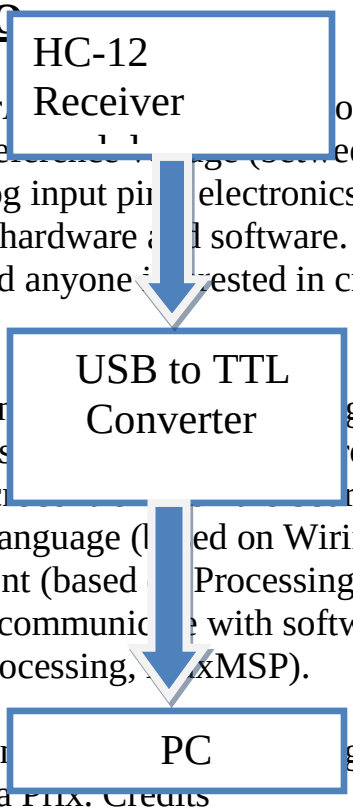
TRANSMITTER



RECEIVER

# 4.HARDWARE TOOLS

## 4. 1.ARDUINO UNO




Arduino is an open-sour og Reference. It is sometimes, used to set an external re een 0 and 5 Volts) as the upper limit for the analog input pi electronics prototyping platform based on flexible, easy-to-use hardware a l software. It's intended for artists, designers, hobbyists, and anyone i ested in creating interactive objects or environments.

Arduino can sense the e g input from a variety of sensors and can affect its olling lights, motors, and other actuators. The mic rd is programmed using the Arduino programming language (l ed on Wiring) and the Arduino development environment (based Processing). Arduino projects can be stand-alone or they can communic with software on running on a computer (e.g. Flash, Processing, xMSP).

Arduino received an Hon gital Communities section of the 2006 Ars Electronica Prix. Credits

Arduino Nano overview:

Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a smallest, complete, and breadboard friendly. It has everything that Diecimila/Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The Nano is automatically sense and switch to the higher potential source of power, there is no need for the power select jumper.

Nano’s got the breadboard-ability of the Boarduino and the Mini+USB with smaller footprint than either, so users have more breadboard space. It’s got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN,

GND on one top, power and ground on the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It is two layers. That make it easier to hack and more affordable.

You end up paying less with Nano than Mini and USB combined!

Specifications:

| | |
|---|---|
| Microcontroller | Atmel ATmega328 |
| Operating Voltage (logic level) | 5 V |
| Input Voltage (recommended) | 7-12 V |
| Input Voltage (limits) | 6-20 V |
| Digital I/O Pins | 14 (of which 6 provide PWM output) |
| Analog Input Pins | 8 |
| DC Current per I/O Pin | 40 mA |
| Flash Memory | 32 KB (of which 2KB used by bootloader) |
| SRAM | 2 KB |
| EEPROM | 1 KB |
| Clock Speed | 16 MHz |
| Dimensions | 0.70” x 1.70” |

Features:

- Automatic reset during program download
- Power OK blue LED
- Green (TX), red (RX) and orange (L) LED
- Auto sensing/switching power input
- Small mini-B USB for programming and serial monitor
- ICSP header for direct program download
- Standard 0.1” spacing DIP (breadboard friendly)
- Manual reset switch

Power:

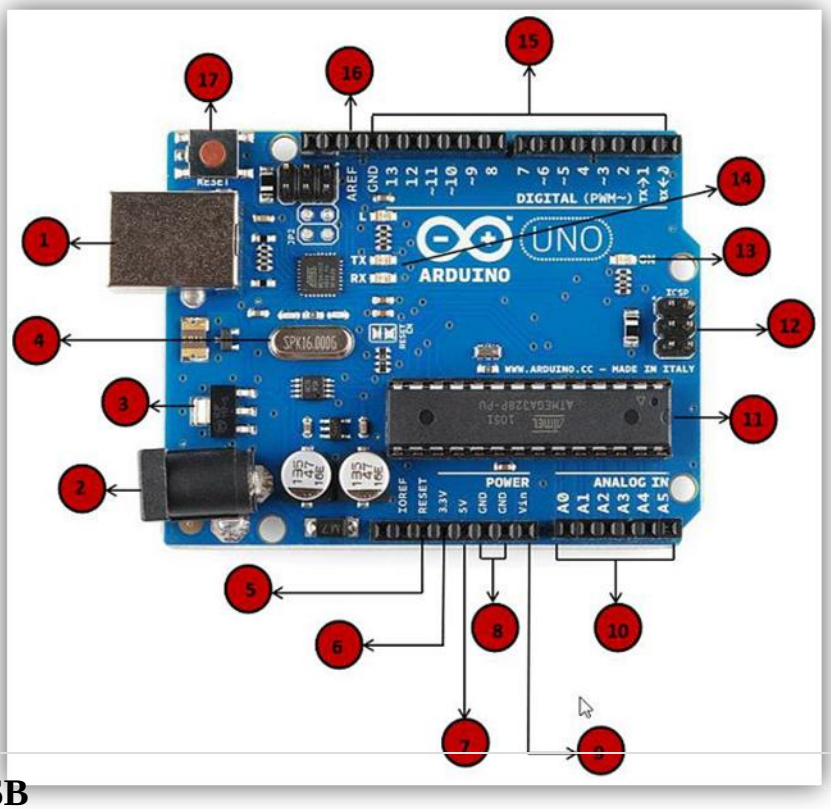
The Arduino Nano can be powered via the mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

The key features are −

- Arduino boards are able to read analog or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions.
- You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).
- Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. You can simply use a USB cable.
- Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program.
- Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

**BOARD DESCRIPTION:**

**Fig4.4.1: Arduino board description**




| | |
|---|---|
| 1 | **Power USB**<br>Arduino board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection (1). |
| 2 | **Power (Barrel Jack)**<br>Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack (2). |

**TABLE4.4.1:Pin specification of Arduino:**

| | |
|---|---|
| 3 | **Voltage Regulator**<br>The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements. |
| 4 | **Crystal Oscillator**<br>The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz. |
| 5,17 | **Arduino Reset**<br>You can reset your Arduino board, i.e., start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, you can connect an external reset button to the Arduino pin labelled RESET (5). |
| 6,7 8,9 | **Pins (3.3, 5, GND, Vin)**<br>• 3.3V (6) − Supply 3.3 output volt<br>• 5V (7) − Supply 5 output volt<br>• Most of the components used with Arduino board works fine with 3.3 volt and 5 volt.<br>• GND (8)(Ground) − There are several GND pins on the Arduino, any of which can be used to ground your circuit.<br>• Vin (9) − This pin also can be used to power the Arduino board from an external power source, like AC mains power supply. |
| 10 | **Analog pins**<br>The Arduino UNO board has six analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor. |

| | |
|---|---|
| 11 | **Main microcontroller**<br>Each Arduino board has its own microcontroller (11). You can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet. |
| 12 | **ICSP pin**<br>Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output. Actually, you are slaving the output device to the master of the SPI bus. |
| 13 | **Power LED indicator**<br>This LED should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection. |
| 14 | **TX and RX LEDs**<br>On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led (13). The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process. |

| | |
|---|---|
| 15 | **Digital I/O**<br>The Arduino UNO board has 14 digital I/O pins (15) (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled "~" can be used to generate PWM. |
| 16 | **AREF**<br>AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins. |

## 4.2.LCD (LIQUID CRYSTAL DISPLAY):

LCD (Liquid Crystal Display) is a type of flat panel display which uses liquid crystals in its primary form of operation. LEDs have a large and varying set of use cases for consumers and businesses, as they can be commonly found in smartphones, televisions, computer monitors and instrument panels. It is is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass through the other.

**Types of LCDs**

Types of LCDs include:

- Twisted Nematic (TN)- which are inexpensive while having high response times. However, TN displays have low contrast ratios, viewing angles and color contrasts.
- In Panel Switching displays (IPS Panels)- which boast much better contrast ratios, viewing angles and colour contrast when compared to TN LCDs.

- Vertical Alignment Panels (VA Panels)- which are seen as a medium quality between TN and IPS displays.
- Advanced Fringe Field Switching (AFFS)- which is a top performer compared IPS displays in colour reproduction range.

Many microcontroller devices use 'smart LCD' displays to output visual information. LCD displays designed around LCD NT-C1611 module, are inexpensive, easy to use, and it is even possible to produce a readout using the 5X7 dots plus cursor of the display. They have a standard ASCII set of characters and mathematical symbols. For an 8-bit data bus, the display requires a +5V supply plus 10 I/O lines (RS RW D7 D6 D5 D4 D3 D2 D1 D0). For a 4-bit data bus it only requires the supply lines plus 6 extra lines(RS RW D7 D6 D5 D4). When the LCD display is not enabled, data lines are tri-state and they do not interfere with the operation of the microcontroller.

FEATURES:

(1) Interface with either 4-bit or 8-bit microprocessor.
(2) Display data RAM
(3) 80x□ 8 bits(80 characters).
(4) Character generator ROM
(5). 160 different 5 □ □ 7 dot matrix character patterns.
(6). Character generator RAM
(7) 8 different user programmed 5 □ □ 7 dot matrix patterns.
(8)Display data RAM and character generator RAM may be Accessed by the microprocessor.
(9) Numerous instructions
(10) Clear Display, Cursor Home, Display ON/OFF, Cursor ON/OFF, Blink Character, Cursor Shift, Display Shift.
(11). Built-in reset circuit is triggered at power ON.
(12). Built-in oscillator.

PIN DESCRIPTION:

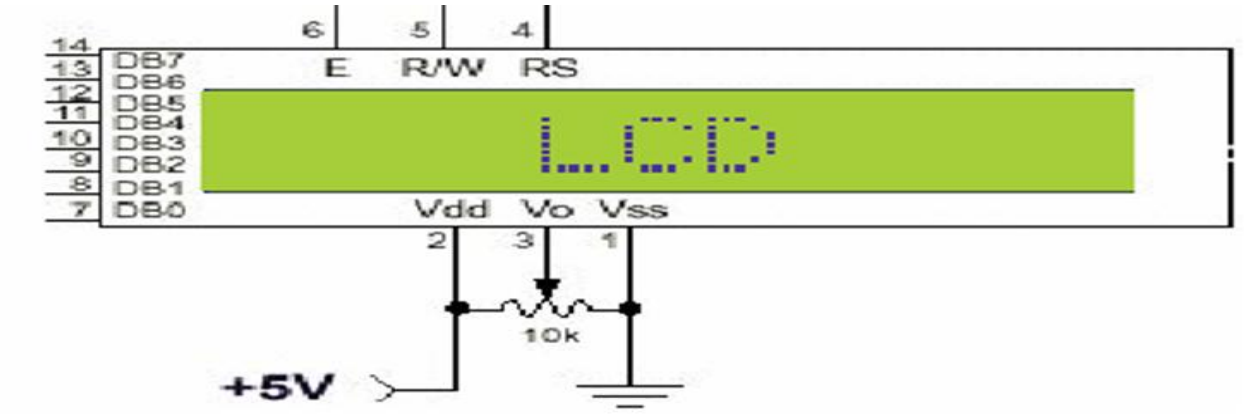



**Fig4.4.2 : pin diagram of 1x16 lines LCD**

**TABLE4.2:Pin specifications of LCD:**

| PIN | SYMBOL | FUNCTION |
|---|---|---|
| 1 | Vss | Power Supply(GND) |
| 2 | Vdd | Power Supply(+5V) |
| 3 | Vo | Contrast Adjust |
| 4 | RS | Instruction/Data Register Select |
| 5 | R/W | Data Bus Line |
| 6 | E | Enable Signal |
| 7-14 | DB0-DB7 | Data Bus Line |
| 15 | A | Power Supply for LED B/L(+) |
| 16 | K | Power Supply for LED B/L(-) |

**FEATURES:**

- 5 x 8 dots with cursor
- Built-in controller (KS 0066 or Equivalent)
- + 5V power supply (Also available for + 3V)
- 1/16 duty cycle
- B/L to be driven by pin 1, pin 2 or pin 15, pin 16 or A.K (LED)
- N.V. optional for + 3V power supply

## 4.3.EM-18 RFID READER:

EM-18 RFID reader is one of the commonly used RFID readers to read 125KHz tags. It features low cost, low power consumption, small form factor and easy to use. It provides both UART and Wiegand26 output formats. It can be directly interfaced with microcontrollers using UART and with PC using an RS232 converter.

**Fig 4.3: EM-18 RFID Reader Module**


**Fig 4.4:2D-Model of EM-18 Reader**

**EM-18 PIN CONFIGURATION:**

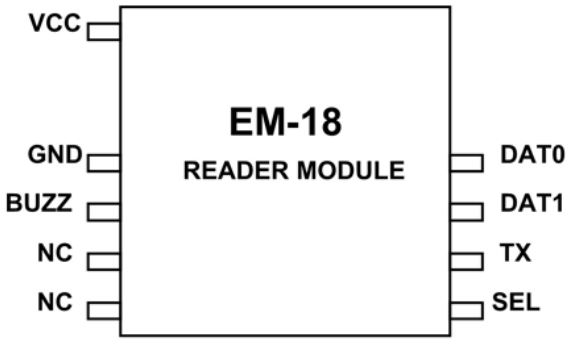


**Fig4.4.5: RFID Reader Pin Out**

EM-18 is a nine- pin device. Among nine pins, 2 pins are not connected, so we basically have to consider seven terminals.

**TABLE 4.3:Pin configuration of em-18 module**

| Pin Number | Description |
|---|---|
| VCC | Should be connected to positive of power source. |
| GND | Should be connected to ground. |
| BUZZ | Should be connected to BUZZER |
| NC | No Connection |
| NC | No Connection |

| | |
|---|---|
| SEL | SEL=1 then o/p =RS232<br>SEL=0then o/p=WEIGAND |
| TX | DATA is given out through TX of RS232 |
| DATA1 | WEIGAND interface DATA HIGH pin |
| DATA0 | WEIGAND interface DATA LOW pin |

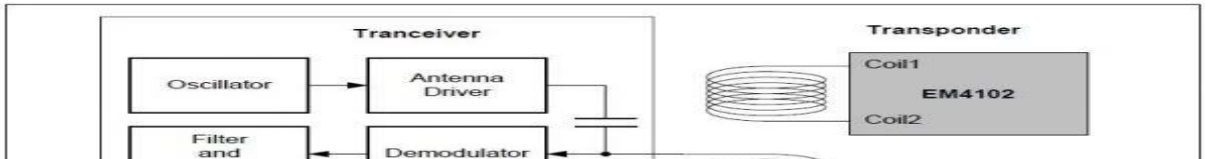
**EM-18 FEATURES &SPECIFICATIONS:**

- Operating voltage of EM-18: +4.5V to +5.5V
- Current consumption:50mA
- Can operate on LOW power
- Operating temperature: 0ºC to +80ºC
- Operating frequency:125KHz
- Communication parameter:9600bps
- Reading distance: 10cm, depending on TAG
- Integrated Antenna

**WORKING OF EM-18 RFID READER MODULE:**

The module radiates 125KHz through its coils and when a 125KHz passive RFID tag is brought into this field it will get energized from this field. These passive RFID tags mostly consist of CMOS IC EM4102 which can get enough power for its working from the field generated by the reader.

**Fig4.4.6: RFID – System Principle**



By changing the modulation current through the coils, tag will send back the information contained in the factory programmed memory array.

## 4.4 RFID TAG:

RFID tags are a type of tracking system that uses smart barcodes in order to identify items. RFID is short for "radio frequency identification," and as such, RFID tags utilize radio frequency technology. These radio waves transmit data from the tag to a reader, which then transmits the information to an RFID computer program. RFID tags are frequently used for merchandise, but they can also be used to track vehicles, pets, and even patients with Alzheimer's disease. An RFID tag may also be called an RFID chip.

RFID tag includes microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number.

**Fig4.4.7:RFID Tag**

**Fig 4.4.8:RFID Tag Inside**.

There are two main types of RFID tags: battery-operated and passive. As the name suggests, battery-operated RFID tags contain an onboard battery as a power supply, whereas a passive RFID tag does not, instead working by using electromagnetic energy transmitted from an RFID reader. Battery-operated RFID tags might also be called active RFID tags.

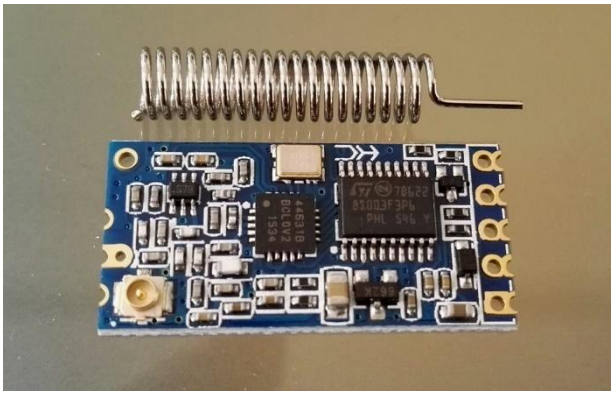
Passive RFID tags are a much more economical choice than active RFID tags, and cost around 20 cents each. This makes them a popular choice for supply chain management, race tracking, file management, and access control applications. While a passive RFID tag does not require a direct line of sight to the RFID reader, it has a much shorter read range than an active RFID tag. They are small in size, lightweight, and can potentially last a lifetime.

**WORKING OF RFID TAGS:**

An RFID tag works by transmitting and receiving information via an antenna and a microchip — also sometimes called an integrated circuit or IC. The microchip on an RFID reader is written with whatever information the user wants.

Passive RFID tags use three main frequencies to transmit information: 125 – 134 KHz, also known as Low Frequency (LF), 13.56 MHz, also known as High Frequency (HF) and Near-Field Communication (NFC), and 865 – 960 MHz, also known as Ultra High Frequency (UHF). The frequency used affects the tag's range. When a passive RFID tag is scanned by a reader, the

reader transmits energy to the tag which powers it enough for the chip and antenna to relay information back to the reader. The reader then transmits this information back to an RFID computer program for interpretation. There are two main types of passive RFID tags: inlays and hard tags. Inlays are



typically quite thin and can be stuck on various materials, whereas hard tags are just as the name suggests, made of a hard, durable material such as plastic or metal.

**APPLICATIONS:**

Although RFID tags have similar applications to barcodes, they are far more advanced. For instance, reading information from a RFID tag does not require line-of-sight and can be performed over a distance of a few meters. This also means that a single tag can serve multiple readers at a time, compared to only one for a bar code tag.

These tags can be attached to almost any object. Although the usual target objects are apparel, baggage, containers, construction materials, laundry and bottles, they also may be attached to animals, humans and vehicles. Some RFID tags are designed for rugged, outdoor-based applications.

These are built to endure natural and incandescent light, vibration, shock, rain, dust, oil and other harsh conditions. They are normally passive in that to function; they do not require batteries and can operate 24/7 without risk of power loss. Such heavy-duty tags are usually attached to trucks, cargo containers and light rail cars for cargo tracking, fleet management, vehicle tracking, vehicle identification and supply container tracking, among others.

## 4.5.HC-12 TRANSCEIVER:

HC-12 wireless serial port communication module is a new-generation multichannel embedded wireless data transmission module. Its wireless

working frequency band is 433.4-473.0MHz, multiple channels can be set, with the stepping of 400 KHz, and there are totally 100 channels. The maximum transmitting power of module is 100mW (20dBm), the receiving sensitivity is -117dBm at baud rate of 5,000bps in the air, and the communication distance is 1,000m in open space.

**Fig 4.4.9: HC12 transciever**

The module is encapsulated with stamp hole, can adopt patch welding, and its
dimension is 27.8mm × 14.4mm × 4mm (including antenna cap, excluding spring
antenna), so it is very convenient for customers to go into application system. There is


a PCB antenna pedestal ANT1 on the module, and user can use external antenna of
433M frequency band through coaxial cable; there is also an antenna solder eye
ANT2 in the module, and it is convenient for user to weld spring antenna. User could
select one of these antennas according to use requirements.

There is MCU inside the module, and user don’t need to program the module
separately, and all transparent transmission mode is only responsible for receiving and
sending serial port data, so it is convenient to use. The module adopts multiple serial
port transparent transmission modes, and user could select them by AT command
according to use requirements. The average working current of three modes FU1, FU2
and FU3 in idle state is 80μa, 3.6mA an 16mA respectively, and the maximum
working current is 100mA (in transmitting state).

**The Si4463 Transceiver**

The Si4463 provides the wireless communication in this circuit. It has a maximum transmit power of 20 dBm (100 mW) and receive sensitivity of -129 dBm. Two 64-byte Rx and Tx FIFO memories are built into the chip along with a great many advanced features that are not implemented in the HC-12 design. See the datasheet for more information on multiband operation, frequency hopping, etc.

**The STM8S003FS Microcontroller**

This is an 8-bit microcontroller with 8 kB of flash memory, 128 bytes of EEPROM, and a 10-bit ADC. It supports UART, SPI, and I²C and has multiple I/O pins. It offers many of the same capabilities as its ATMega and XMC counterparts. It is programmed to control the Si4463 as well as handle the UART communication between the HC-12 and whatever it is connected to on the other end.

**The HC-12 Transceiver Module**

Combined with other components, the Si4463 and STM8S003 create the HC-12 transceiver, which provides a 4-pin TTL-level UART interface (Vcc, Gnd, Tx, Rx), with a 5th pin that is used to enter "command" mode for changing the module's configuration. The HC-12 has 100 supported channels spaced 400 kHz apart, eight transmit levels, eight supported baud rates, and three different working modes.

**FEATURES:**

- Long-distance wireless transmission (1,000m in open space/baud rate 5,000bps in
- the air)
- Working frequency range (433.4-473.0MHz, up to 100 communication channels)
- Maximum 100mW (20dBm) transmitting power (8 gears of power can be set)
- Three working modes, adapting to different application situations
- Built-in MCU, performing communication with external device through serial
- port
- The number of bytes transmitted unlimited to one time
- Update software version through serial port

**SPECIFICATIONS**

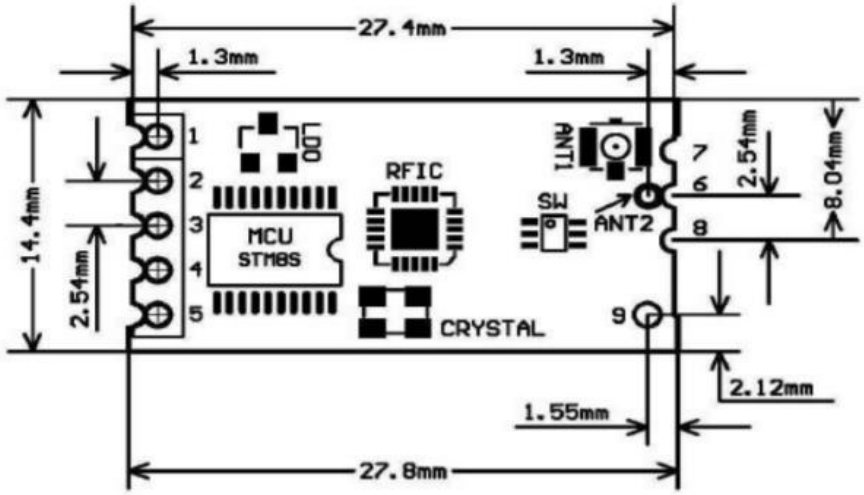
• Working frequency: 433.4MHz to 473.0MHz
• Supply voltage: 3.2V to 5.5VDC
• Communication distance: 1,000m in the open space
• Serial baud rate: 1.2Kbps to 115.2Kbps（default 9.6Kbps）
• Receiving sensitivity: -117dBm to -100dBm
• Transmit power: -1dBm to 20dBm
• Interface protocol: UART/TTL
• Operating temperature: -40℃to +85℃
• Dimensions: 27.8mm x 14.4mm x 4mm

## PIN CONFIGURATION:

**Fig:4.5.0:pin diagram of HC12 module**

**TABLE4.4:Pin description of HC-12 Module**

| Pin | Definition | I/O direction | Description |
|---|---|---|---|
| | | | |




| | | | |
|---|---|---|---|
| 1 | VCC | | Power supply input, DC3.2V-5.5V, with load capacity not less than 200mA. (Note: If the module is working in transmitting state for a long time, it is suggested that one 1N4007 diode should be connected in series when the power voltage is greater than 4.5V, to avoid heating of built-in LDO of module.) |
| 2 | GND | | Common ground |

| | | | |
|---|---|---|---|
| 3 | RXD | Input, weak pull-up | URAT input port, TTL level; 1k resistance has been connected in series inside |
| 4 | TXD | Output | URAT output port, TTL level; 1k resistance has been connected in series inside |
| 5 | SET | Input, internal 10k pull-up resistance | Parameter setting control pin, valid for low level; 1k resistance has been connected in series inside |
| 6 | ANT | Input/Output | 433MHz Antenna Pin |
| 7 | GND | | Common ground |
| 8 | GND | | Common ground |
| 9 | NC | | No Connection, used in fixing, compatible with HC-11 module pin position |
| ANT-1 | ANT | Input/ Output | IPEX20279-001E-03 antenna socket |
| ANT-2 | ANT | Input/ Output | 433MHz spring antenna solder eye |

The 5th pin on the HC-12 is labelled "Set" and, when driven to logic low, allows various settings to be selected on the HC-12 using AT commands sent to the "RXD" pin.

The default configuration of the HC-12 is FU3—on Channel 1, FU3 is a fully automatic and transparent (to other devices) setting that adapts to the transmission rate of the connected device (although 9600 baud is still required to program it in Command mode).

Note that as the transmission rate increases, the sensitivity of the receiver decreases. You can return to the default state by sending AT+DEFAULT once in command mode.

| **Serial Port Baud Rate** | **Over-the-Air Baud Rate** | **Receiver Sensitivity** |
|---|---|---|

| | | |
|---|---|---|
| 1200 bps | 5000 bps | -117 dBm |
| 2400 bps | 5000 bps | -117 dBm |
| 4800 bps | 15000 bps | -112 dBm |
| 9600 bps | 15000 bps | -112 dBm |
| 19200 bps | 58000 bps | -107 dBm |
| 38400 bps | 58000 bps | -107 dBm |
| 57600 bps | 236000 bps | -100 dBm |
| 115200 bps | 236000 bps | -100 dBm |

**INSTRUCTIONS:**

**1. AT**

Test instructions

Example: Send module commands "AT", the module returns "OK".

**2. AT + Bxxxx**

Change the serial port baud rate command. You can set the baud rate is 1200bps, 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, 57600bps and 115200bps. The factory default is 9600bps.

Example: Set the module serial port baud rate is 19200bps, please send module command "AT + B19200", the module returns
"OK + B19200".

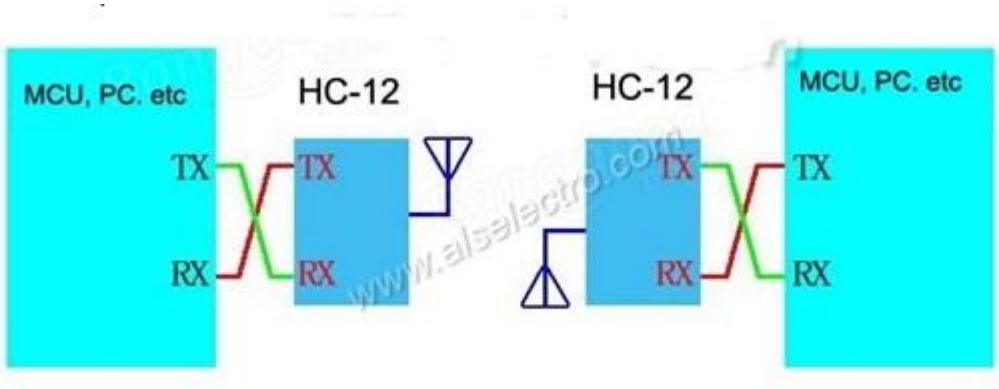
**3. AT + Cxxx**

Change the wireless communication channel, selectable from 001 to 127 (more than 100 radio channels after the communication distance not guaranteed). The default value is 001 radio channels, operating frequency is 433.4MHz. Step channel is 400KHz, the operating frequency of the channel 100 is 473.0 MHz.

Example:
Set module to channel 21, please send module command "AT + C021", the module returns "OK + C021".
After exiting the command mode, the module in the first 21 channels, operating frequency is 441.4 MHz.
Note: Because the wireless receiver module sensitivity HC-12 is relatively high, the baud rate is greater than when air 58000 bps, 5 must be shifted to the adjacent channel use. When the air baud rate is not greater than 58000 bps, if the short distance (10 meters) communication, but also need to stagger five adjacent channel use.

**4. AT + FUx**
Change the module serial pass-through mode, there FU1, FU2 and FU3 three modes. Module default mode is FU3, two serial pass-through mode module must be set to the same communication. See detailed above, "wireless serial pass-through" part.
Example: Send module commands "AT + FU1", the module returns "AT + OK".

**5. AT + Px**
The default setting is 8, maximum transmit power, communication distances. Transmit power level is set to 1, the minimum transmission power. In general, the transmission power of each drop 6dB, communication distance will be reduced by half.
Example: Send module commands "AT + P 5", the module returns "OK + P5". After exiting the command mode, the module transmit power is +11 dBm.




Each HC-12 can work in one of the following modes:

1. FU1 – moderate power saving mode with 250000bps "over the air" baud rate. Serial port baud rate can be set to any supported value
2. FU2 – extreme power saving mode with 250000bps "over the air" speed. Serial port rate is limited to 1200bps, 2400bps, 4800bps
3. FU3 – default, general purpose mode. "Over the air" speed differs depending on serial port speed. The same goes for maximum range:
    - 1200bps ~ 1000m
    - 2400bps ~ 1000m
    - 4800bps ~ 500m
    - 9600bps ~ 500m
    - 19200bps ~ 250m
    - 38400bps ~ 250m
    - 57600bps ~ 100m
    - 115200bps ~ 100m
4. FU4 (available in version 2.3 or newer) – long-range mode. "Over the air" speed is limited to 500bps and serial port speed to 1200bps. Because airspeed is lower than port speed, only small packets can be

sent: max 60 bytes with the interval of 2 seconds. In this mode, range is increased to 1800m.

Pair of HC-12 that creates a wireless link has to work in the same mode (FU1, FU2, FU3, FU4) and with the same speed.

**APPLICATIONS:**

- Wireless sensor
- Community building security
- Robot wireless control
- Industrial remote control and telemetering
- Automatic data acquisition
- Container information management
- POS system
- Wireless acquisition of gas meter data
- Vehicle keyless entry system
- PC wireless networking

## 4.6.PUSH BOTTON:

A push button is a simple type of switch that controls an action in a machine or some type of process. Most of the time, the buttons are plastic or metal. The shape of the push button may conform to fingers or hands for easy use, or they may simply be flat. It all depends on the individual design. The push button can be normally open or normally closed.

**WORKING:**

Push button switches have three parts. The actuator, stationary contacts, and the grooves. The actuator will go all the way through the switch and into a thin cylinder at the bottom. Inside is a movable contact and spring. When someone presses the button, it touches with the stationary contacts, causing the action to take place. In some cases, the user needs to keep holding the button, or to press it repeatedly, for an action to take place. With other push buttons, a latch connects and keeps the switch on until the user presses the button again.

**APPLICATIONS:**

Push button switches are popular in a variety of different applications, including calculators, push button phones, and many home appliances. You can find them in the home, the office, and in industrial applications today. They can turn machines on and off, or cause the devices to perform specific actions, as is the case with calculators. In some cases, specifically for commercial and industrial usage, the buttons can connect through mechanical linkage, which means that pushing one button can actually cause another button to release.

In many cases, the buttons will have specific coloration to help denote their actions. This ensures that the chance of someone pushing the button by mistake is lower. Red will usually indicate stopping, while green generally indicates starting a machine. Emergency stop buttons, which tend to be large push buttons, are generally red, and they typically have larger heads for easier use.

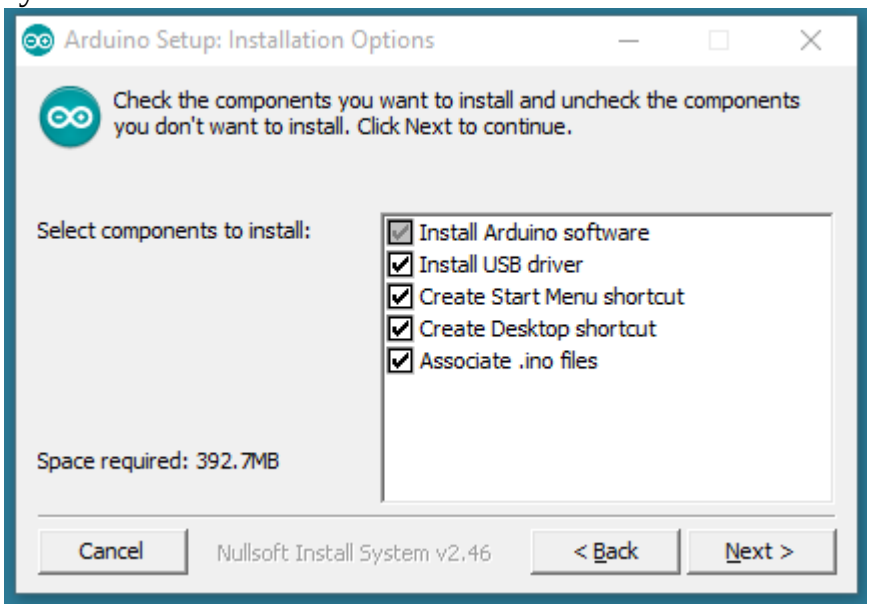
# SOFTWARE TOOLS

## ARDUINO

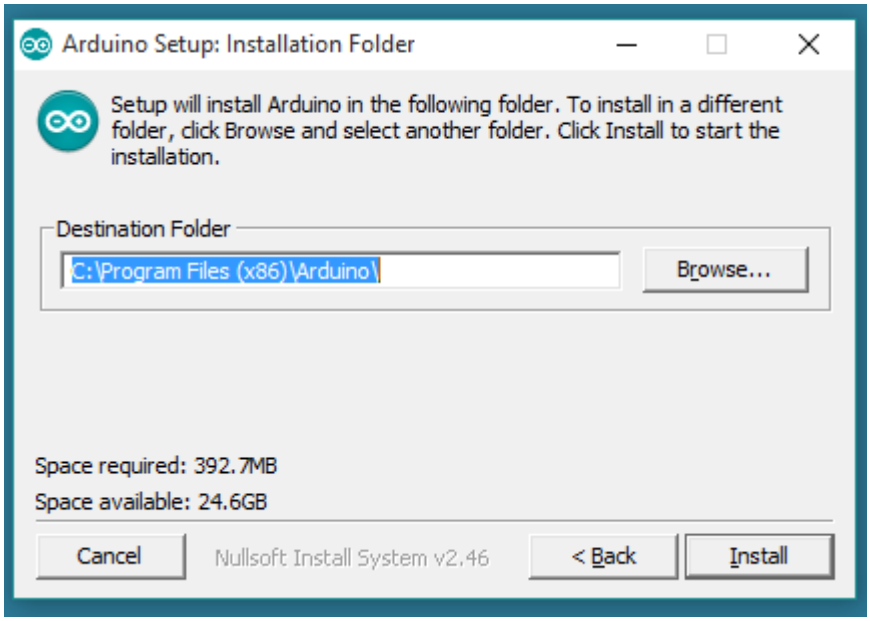
The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software.
This software can be used with any Arduino board

## INSTALLATION

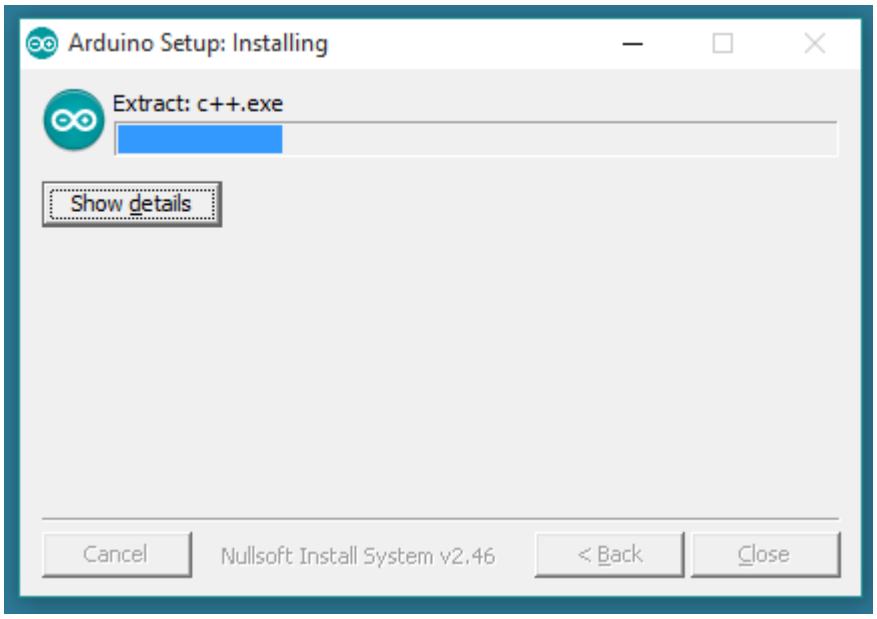
In this project Arduino 4.0is installed. We can choose between the Installer (.exe) and the Zip packages. If  you use the first one that installs directly everything you need to use the Arduino Software (IDE), including the drivers. With the Zip package you need to install the drivers manually. The Zip file is also useful if you want to create a portable installation.
When the download finishes, proceed with the installation and please allow the driver installation process when you get a warning from the operating system.




Choose the components to install




Choose the installation directory ( suggested to keep the default one)




The process will extract and install all the required files to execute properly the Arduino Software (IDE)

## SoftwareSerial Library

The Arduino hardware has built-in support for serial communication on pins 0 and 1 (which also goes to the computer via the USB connection). The native serial support happens via a piece of hardware (built into the chip) called a UART. This hardware allows the Atmega chip to receive serial communication even while working on other tasks, as long as there room in the 64 byte serial buffer.

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.

To use this library,we have to write
#include <SoftwareSerial.h>

**INSTALLATION:**

This can be installed in arduino ide using library manager(contains all libraries)

Limitations

The library has the following known limitations:

- If using multiple software serial ports, only one can receive data at a time.
- Not all pins on the Mega and Mega 2560 support change interrupts, so only the following can be used for RX: 10, 11, 12, 13, 14, 15, 50, 51, 52, 53, A8 (62), A9 (63), A10 (64), A11 (65), A12 (66), A13 (67), A14 (68), A15 (69).
- Not all pins on the Leonardo and Micro support change interrupts, so only the following can be used for RX: 8, 9, 10, 11, 14 (MISO), 15 (SCK), 16 (MOSI).

- On Arduino or Genuino 101 the current maximum RX speed is 57600bps

- On Arduino or Genuino 101 RX doesn't work on Pin 13

## LiquidCrystal I2C library:

The library allows to control I2C displays with functions extremely similar toLiquidCrystal library. 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).

To use this library ,we have to write

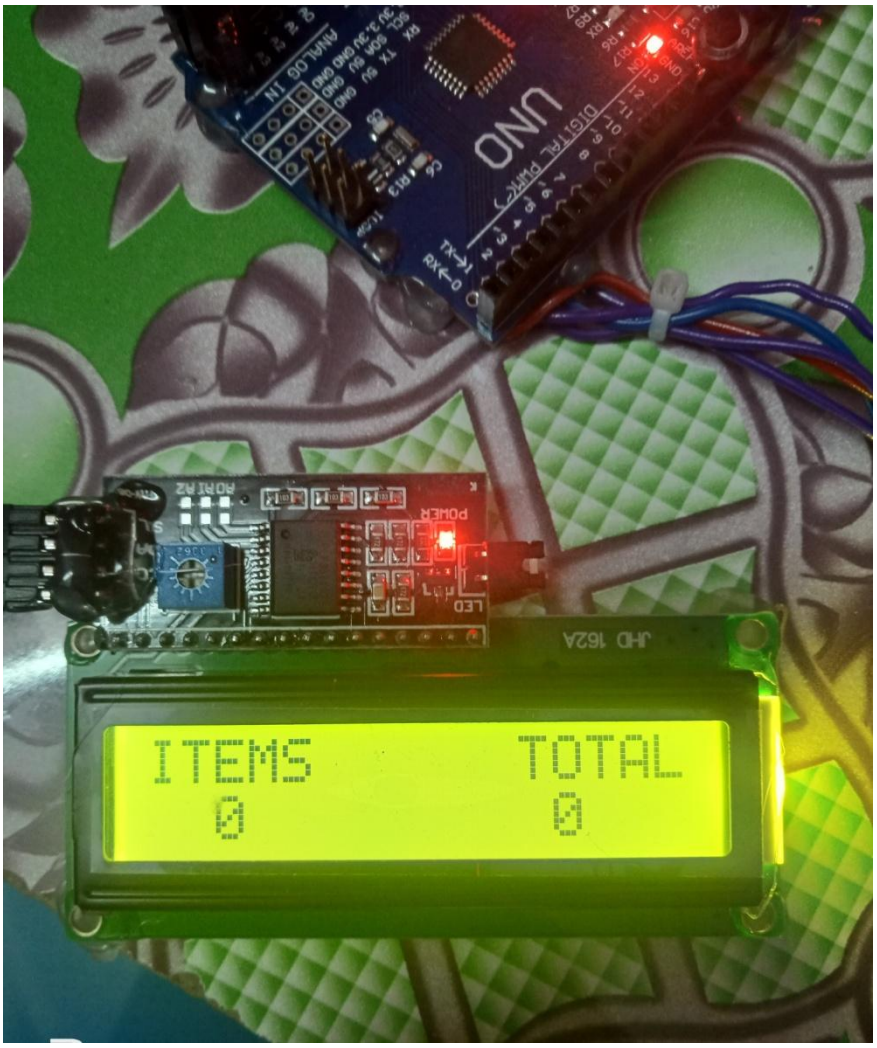
```
#include <LiquidCrystal.h>
```

## INSTALLATION:

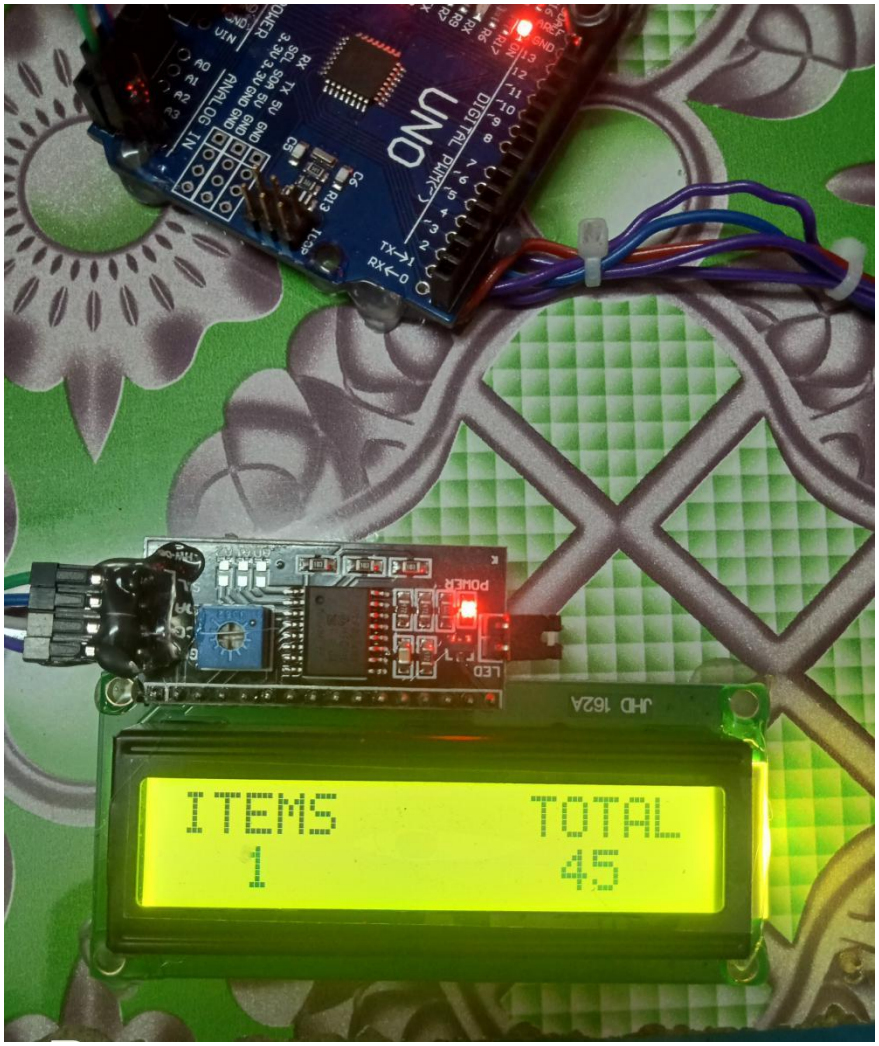
This can be installed in arduino ide using library manager (contains all libraries).

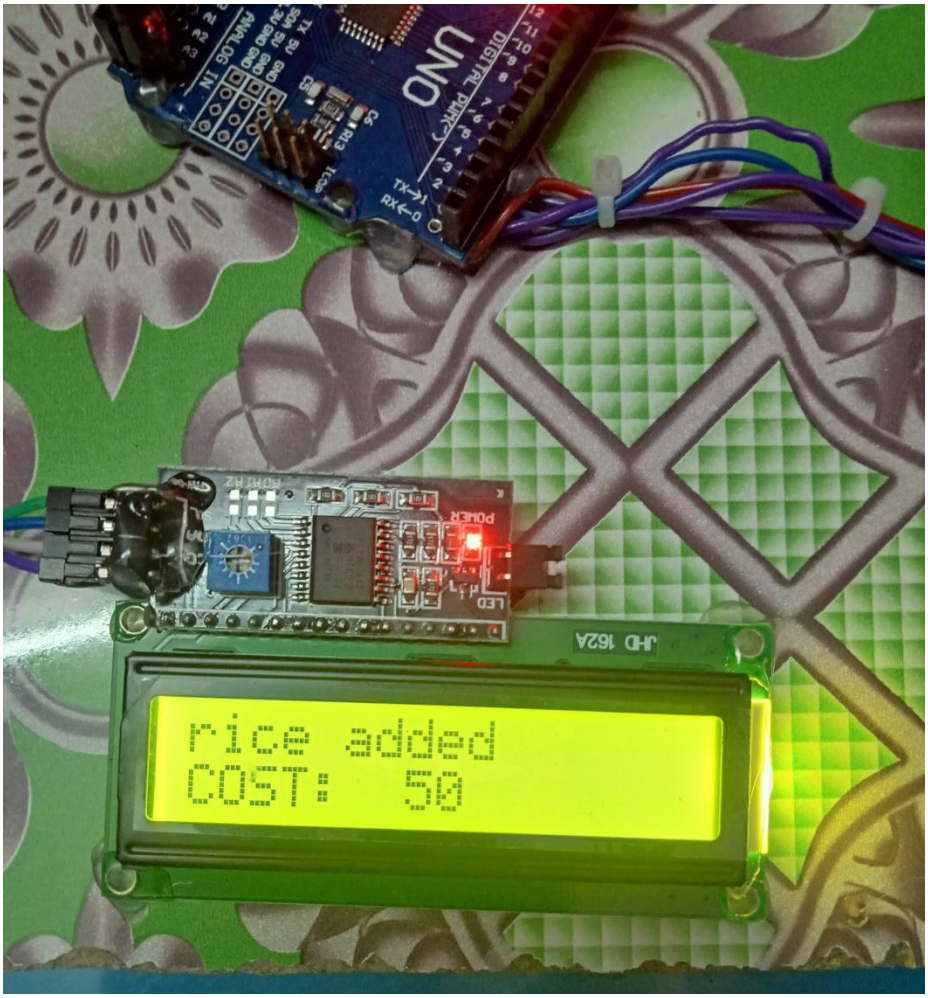
**RESULTS :**

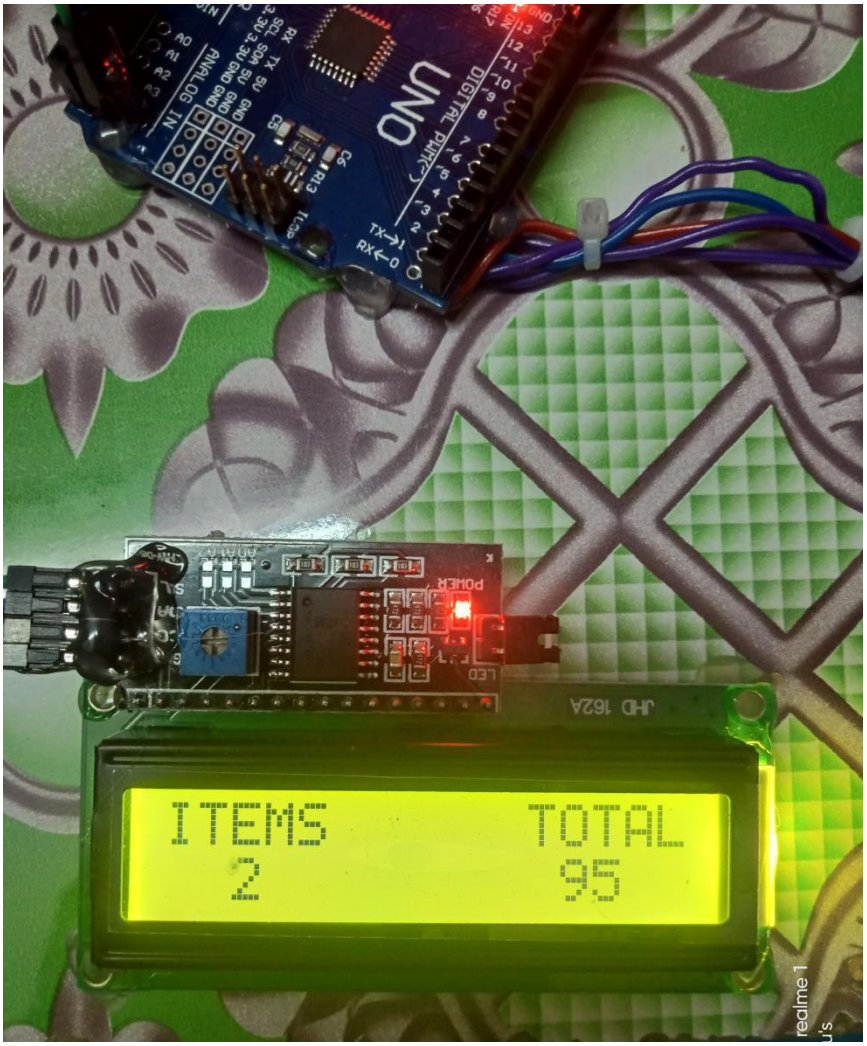

SMART
SHOPPING TROLLY

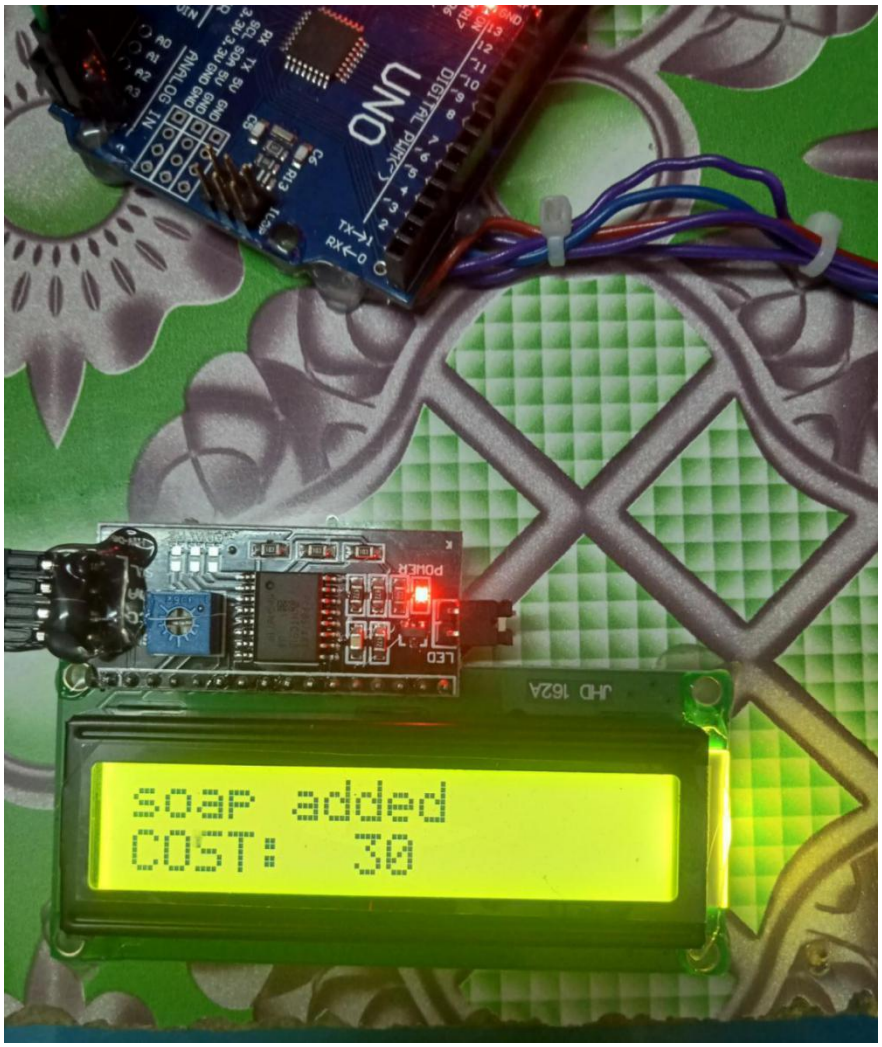

UNO
ITEMS
TOTAL
0
0

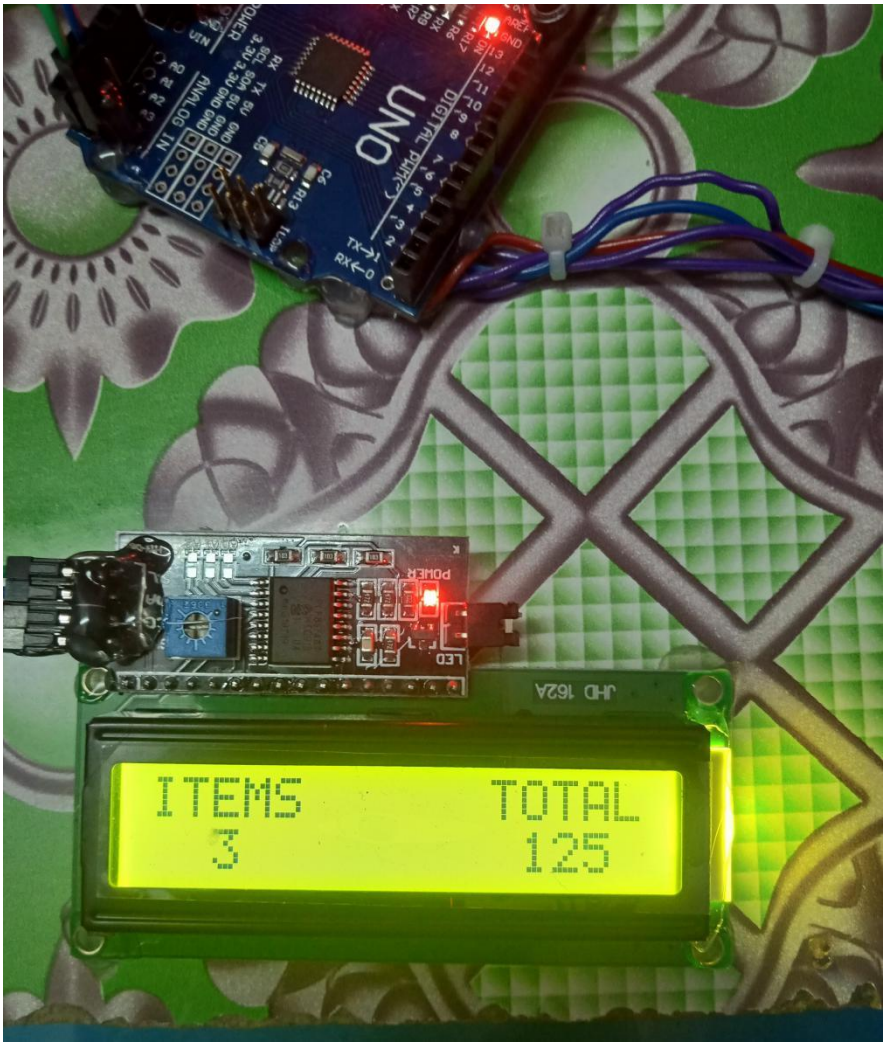

Milk added
COST: 45
POWER
LED
TX→1
RX←0

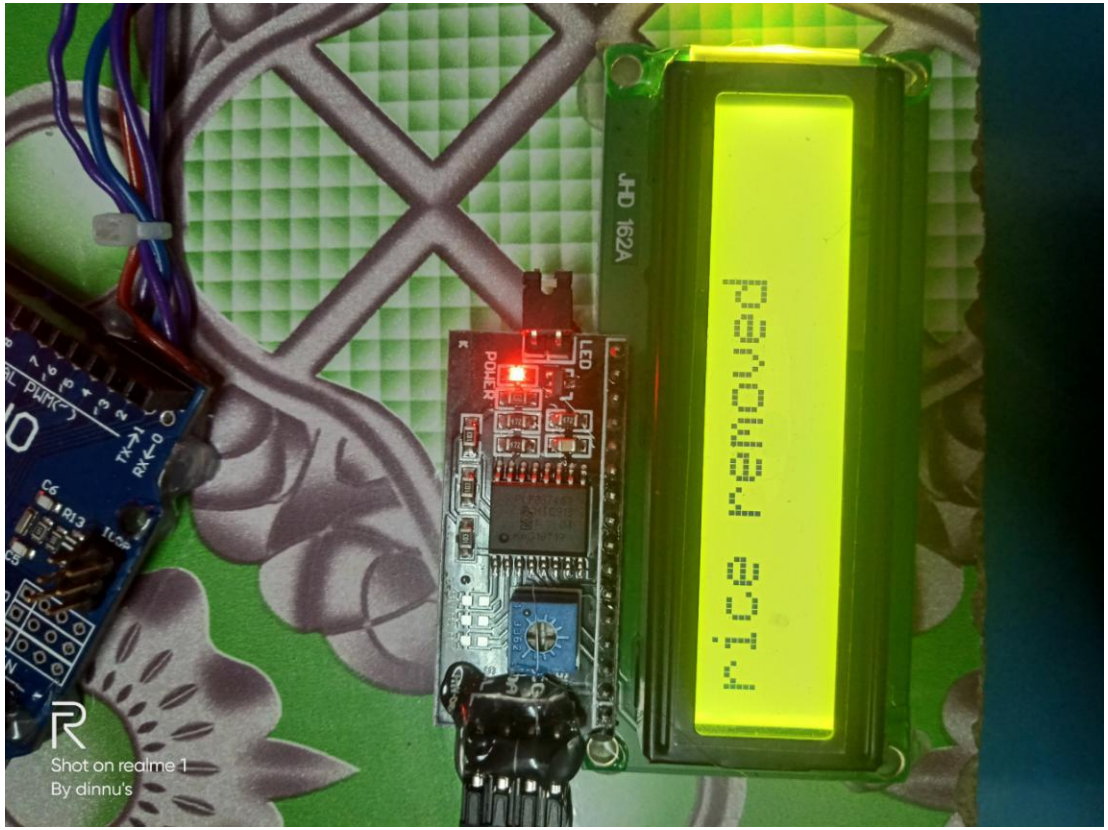

UNO
POWER
LED
JHD 162A
ITEMS
1
TOTAL
45

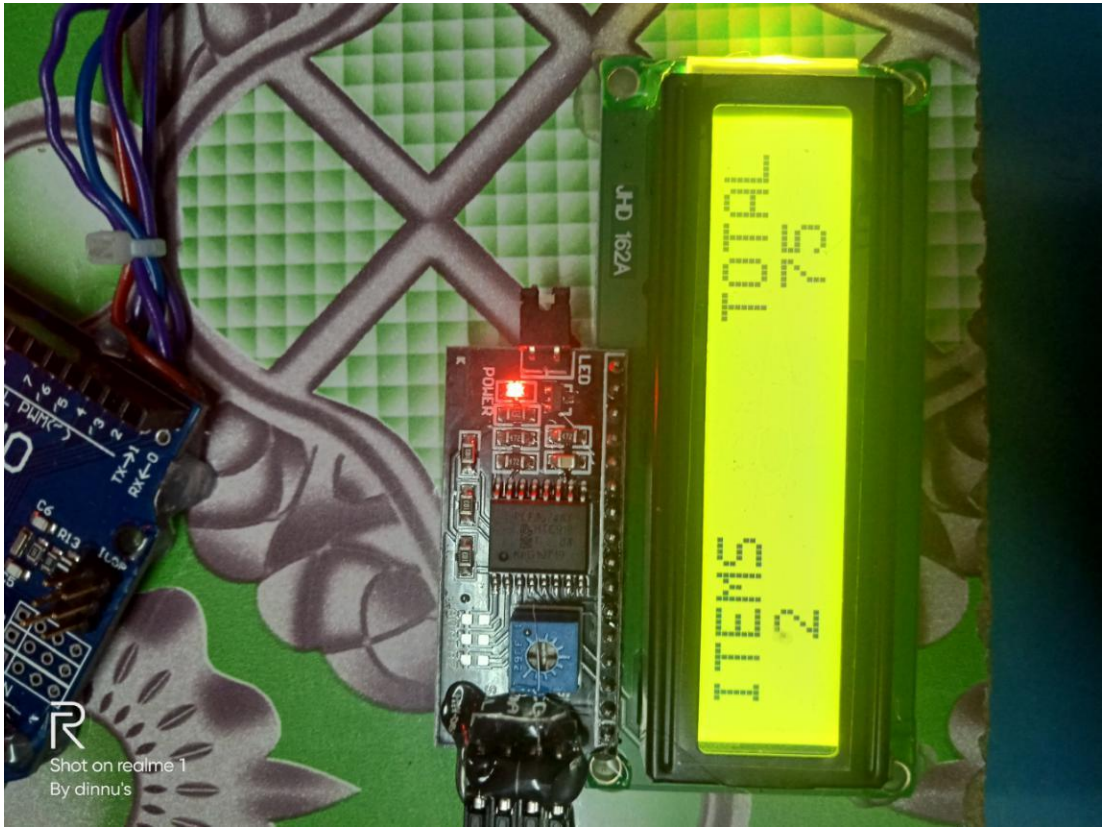

UNO
POWER
LED
JHD 162A
rice added
COST: 50

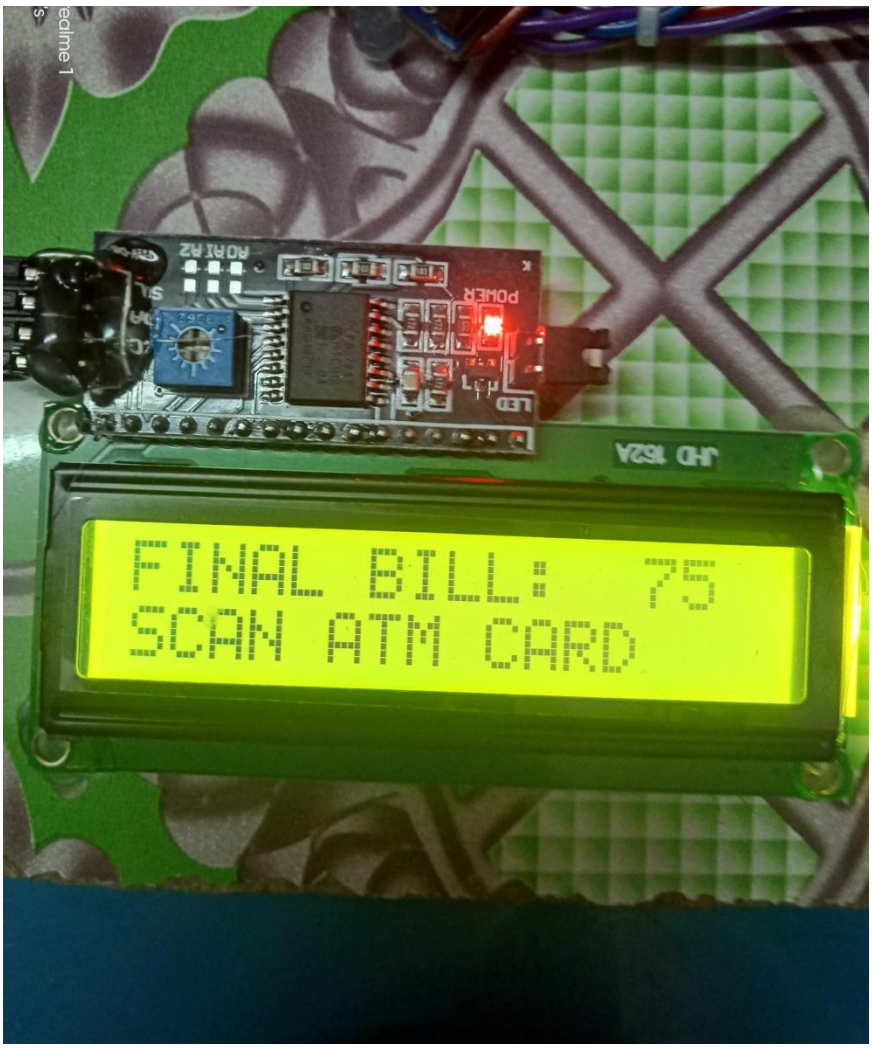

UNO
DIGITAL PWM~
ANALOG IN
POWER
LED
TX→1
RX←0
JHD 162A
ITEMS
2
TOTAL
95

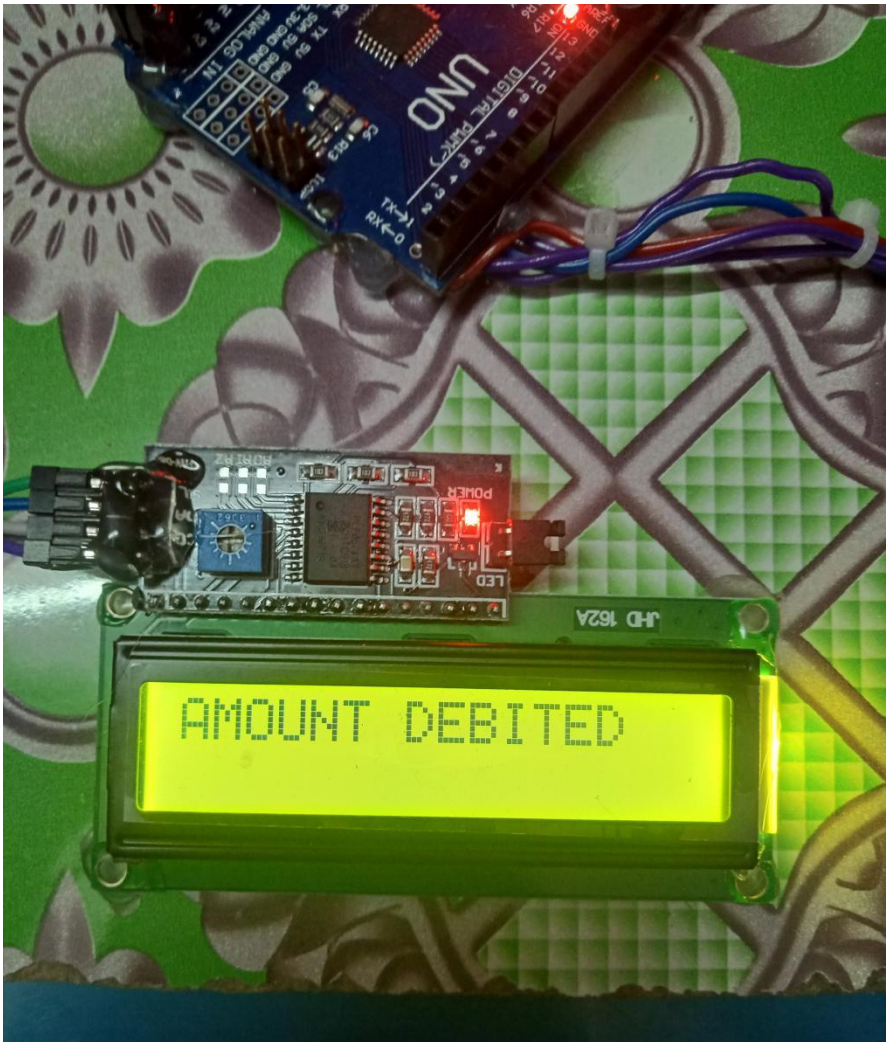

UNO
soap added
COST: 30


UNO
POWER
JHD 162A
ITEMS
3
TOTAL
125

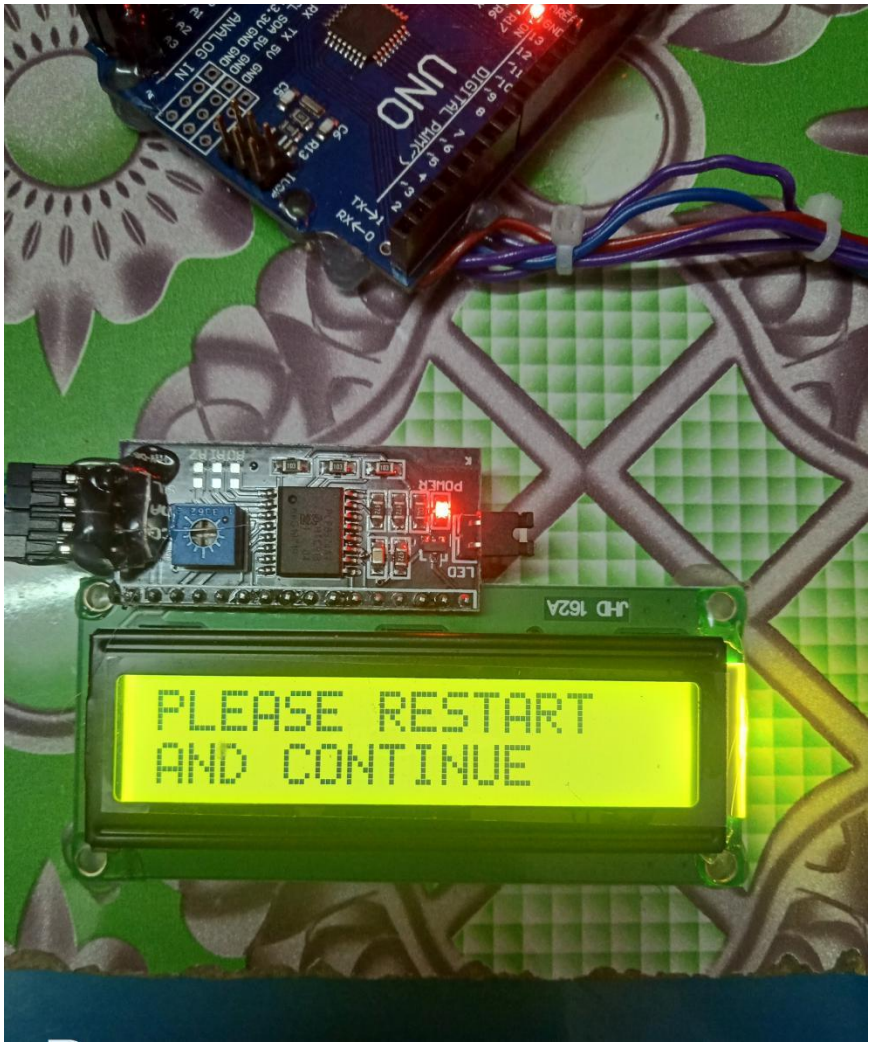

JHD 162A
POWER
LED
Shot on realme 1
By dinnu's


JHD 162A
POWER
LED
Shot on realme 1
By dinnu's


FINAL BILL: 75
SCAN ATM CARD
POWER


UNO
POWER
LED
JHD 162A
AMOUNT DEBITED


THANK YOU
FOR SHOPPING
JHD 162A
POWER
LED


UNO
PLEASE RESTART
AND CONTINUE

# CONCLUSION

The Work done with the help of Rfid technology, EM-18 reader and Arduino. It's aim is to reduce the time of billing in long queues so that the customers gets benefited and the same time inventory management becomes so easy. It can be implemented in shopping malls where there is a large crowd and huge rush into malls.

In the world of Automation, This automatic billing system plays a major role in the upliftment of technology. This technology will replace the present barcode system which is present being followed. Hence this technology can help people to make their life's easy and time saving too.

# REFERENCES


- 1.Chandrashekhar P, Ms.T. Sangeetha "**Smart shopping cart with automatic central billing system through RFID and zigbee**",IEEE,2014
- Hubert, M. blut, C. Brock,C.Backhaus and T.Eberhardt "**Acceptance of smart phone based mobile shopping: mobilebenefits, customercharacteristics, perceived risks and the impact of application context"**,IEEE 2018
- A conference paper on "**Iot Based Smart Shopping Mall**" by 1 Ashok Sutagundar, Masuda Ettinamani, Ameenabegum Attar
- . A conference paper on "**Internet of Things (IOT)Based Smart Shopping Center "** RFID, by Ajay Kumar, shlok Srivastava and U. gupta.
- A conference paper on "**IoT Applications on Secure Smart Shopping System** "by Ruinian Li, Tianyi Song, Nicholas Capurso, Jiguo Yu, Jason Couture, and Xiuzhen Cheng