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Human Following Cart: A Smart Way of Shopping

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ABSTRACT

A store is a location where consumers come to buy and pay for their goods on a daily basis. Therefore, it is necessary to compute that how many goods sold and generate the customer's bill. We have to work to select the exact product when we go to shopping mall for shopping. After that, too, standing in line for the billing of all goods is tiring. We are therefore proposing to build a smart shopping cart that will keep track of purchased goods as well as bill generation.The project is based on board technology from Arduino and RFID readers, as well as some sensors such as GPS, compass and database that combine and make a smart shopping cart. Consumer buys the item and puts it in the cart. As the items are put in the cart, the RFID detector identifies the product and updates the shopping mall's database, if the product is withdrawn from the cart, then the product's billing is cancelled. At the end of the shopping, the total bill will be created on the cart itself. This cart is more than a self-moving cart that reduces human effort. The self-moving function of this cart works with the help of the Arduino board, GPS and compass that follows a person in the mall, and at the bottom of the cart we place the battery and motors that moves the shopping cart.

KEYWORDS: *Smart shopping cart, RFID scanner, Arduino.*

1. INTRODUCTION

Today our lives have been totally changed because of growing technology, the life of common people become very fast, time is very precious for today's generation, therefore people don't have too much time to spend on shopping, they prefer malls instead of shops because they can buy everything from mall like cloths, food items, gadgets, etc but after completion of shopping, long queues are there for billing purpose in the mall, this task is very hectic and time-consuming and also this process always leads to customer dissatisfaction because no one wants to stand in the long queue for getting their item billed, to avoid this problem we purposed a smart human

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

following cart since cart is a basic tool of shopping in the malls it helps the customers to take the required product and move around the mall, by implementing smart cart we reduce man power in mall as well as reduce the time of customer by avoiding the queue because this cart contains auto billing system and will also provide visual updates of the items inside it, this cart will be created using IOT technology by implementing RFID technology along with compass and GPS and some other modules like Arduino Uno, Arduino Nano, Bluetooth module, motors, and batteries, etc.

Figure 1.1: Current shopping environment

2. MOTIVATION

To provide a superiorexperience ofshopping for the customer by saving their valuable time while standing in the long queues of shopping malls for the generation of bills so that eliminate the checkout counters as well as to minimize the manpower required in the mall. To save human effort while lifting the cart in the shopping mall.

3. EXISTING SYSTEM

Amazon made the prototype of the smart cart which includes payment services once the customer is done with shopping. The trolley consists of RFID Scanner which is responsible for getting information related to the product. It will show the list of products on an LCD screen which are kept into a cart. It also generates bills. Once a customer is done with its shopping, the database associated with that smart trolley gets alter after each transition. The main motive of amazon is to make it shopping simpler, private and fast. So the introduced smart trolley which makes the shopping more attractive. Amazon uses Raspberry pi as hardware which is interfaced with different modules like billing, scanning and updating the database. They are not supposed to provide any user-based software but the whole raspberry pi is installed on the trolley as hardware which automatically makes the things certainly easy for the customer. Apart from this RFID Scanner is installer onto the entry section of the trolley and RFID reader sticker is stick on to the product. When RFID or Bar Scanner comes on the belt of RFID Scanner or Bar code scanner installed on to the trolley, it will automatically fetch the information about the product. There is a battery that is installed to give a power source to the raspberry pi and other different components.

4. PROPOSED SYSTEM

This project is based on Arduino board technology, RFID readers, and some sensors like GPS, compass, and database which combine and make a smart cart. The customer buys the product and put it into the cart, As the products are being put in the cart the RFID sensor detect the

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

product and update the database of the shopping mall if the product is taken back from the cart then the billing of that product is being canceled. As the shopping will be completed in the end the total bill will generate on the cart itself. More than that this cart is self-moving which reduces the human effort. The self-moving function of this truly works as, GPS and compass with the help of the Arduino board which follows a person in the mall, and in the downside of the cart, we will place the battery and motors which will move the cart with the help of Arduino and the sensors.

5. IMPLEMENTATION AND DESIGN OF CART

5.1 HARDWARE COMPONENTS USED:

Arduino: It is an open-source electronics platform which is based on easy-to-use software and hardware. It was Invented at the Ivrea Interaction Design Institute as an easiest tool for rapid prototyping, focused on students without having a upbringing in electronics and programming.These boards can read inputs such as: light on a sensor, a finger on a button, or a Twitter message and convert it into an output,initializing a motor, switching on an LED, publishing something online. Wecan modify our board fora specific purpose by transmitting a set of instructions to the board containing microcontroller. We use the Arduino programming language and the Processing-based Arduino Interface (IDE) for such a method. Arduino board began updating to adapt to the latest requirements and challenges as it reached a wider community, segregating its offer from simple 8-bit boards to products for IoT applications, embedded environments, wearable, and3D printing. Each Arduino board is totally open-source, entitling users to design them individualistically and adjust them according to their requirements. From other microcontrollers, platforms, these boards are relatively cheap. The cheapest version of the Arduino module can be gathered by hand and even the reassembled cost is less than 400rs.

Figure 5.1: Arduino module

Compass: Compass version(HMC5883L) is a 3-axis digital compass. This device is used for two general purposes: first, to measure the magnetization of a magnetic material such as a ferromagnet, or to determine the strength and, in this case, the position of the magnetic field at a space point. It's easy to communicate with the HMC5883L and an I2C api. It has a regulator on board. The HMC5883L sensor and all filtering capacitors are included in the break-out panel. The power and 2-wire interface pins are all broken down to a pitch header of 0.1" Uses the famous magnetometer chip HMC5883L. Supports IO levels of 3.0V to 5.0V on I2C SCL and SDA pins.

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

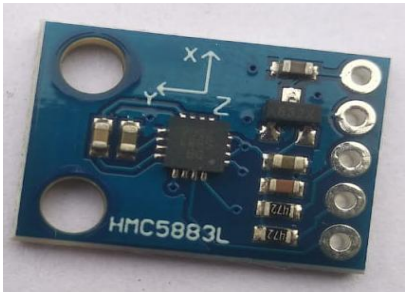


Figure 5.2: Compass module

GPS:GPS is primarily a positioning system that is working on the network of satellites that contentiously transmit information in the coded form. This information transmitted from thesatellite will be interpreted by the receiver to identify the location on earth. This distance is measured by satellite using the formula, Distance = Speed / Time.

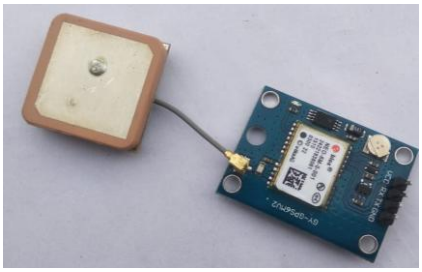


Figure 5.3: GPS module with antenna

Motor Driver: Motor Driver is a dual bi-direction motor driver which is working on L298N dual H-Bridge Motor Driver IC. The said motor driver allows an easy and independent control of two motors up to 2A each in either direction. It is basically used for robotics application and well suited for connection to different kinds of microcontrollers and a couple of codes related to the motor. In this project, we used Arduino UNO to interface Motor Driver.The L293D motor driver model is a standard Motor Driver or Motor Driver IC for driving in any direction. This is a 16-pin IC that controls at the same time in any direction a combination of two DC motors. It means you can use a single L293D IC to control two DC motors. This module functions on the H-bridge definition. H-bridge is a circuit that allows in either direction the voltage to fly. Because we know that voltage needs to change its direction in order to be able to turn the motor in the direction of anticlockwise or clockwise, this H-bridge IC is appropriate for running a DC motor. The IC of L293D chip contains two h-bridge circuits, which can freely rotate two dc motors. Due to its size, it is used for controlling DC motors in the robotic application.

Servo Motor: Tower pro SG90 9g micro Servo motor is a device to be used in IoT devices for rotating purposes. It is a small device that can be used in the device for rotation, for example, we can use it in the car for rotation of wheels, In a door to open it automatically. The best thing about servo motor is it can be connected to Arduino directly. It has three pins one for power, second for signal and third for a signal. We can control our servo motors' rotation angle by

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

applying PWM with it. With the varying width of PWM, we can rotate our servo motor and control its directions.

Figure 5.4: Servo motor

LCD:16*02 LCD is a flat panel display which generally used in TVs and computer monitors. Sometimes it is also used for making Smartphones screen as well. The display of LCD is made up of millions of pixels. LCD is lit by a backlight, and its pixels are switched between on and off electronically while using the liquid crystal to rotate polarized light. There is a polarizing glass filter that is placed between the front and behind of all the pixels where the front pixel is placed on 90 degrees. In between both the filters are liquid crystals that are electronically switched between on and off.

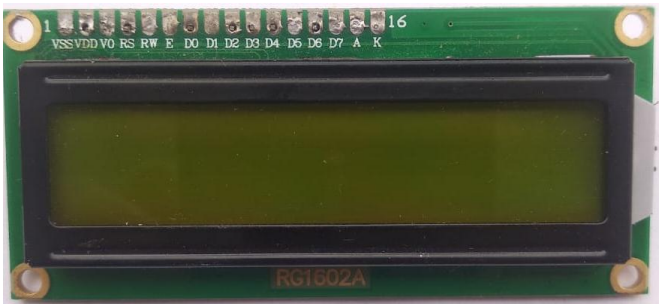


Figure 5.5: LCD

ArduinoNano: It is a microcontroller board based on ATMEGA328P/ATMEGA168. Like Arduino UNO it is also used for a robotics project, embedded systems, etc where ever automation is an essential part of the project. It has 14 digital pins, 8 Analog pins. It is operating on the voltage of 5V, however, the input can vary from 7 to 12V. It has 2 reset pins and 6 power pins as well. Functions like pinMode() and digitalWrite() are used to control the operation of digital pins where asanalogRead() is used for controlling analog pins. It is programmed using Arduino IDE. Each pin of the nano comes with the associated function to it. Multiple GND pins can be applied when we required more GND connection to our project.

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

Figure 5.6: Adruino Nano module

Bluetooth: Bluetooth Module HC-05 used in Arduino for wireless communication, it communicates with microcontroller by using serial communication. We can operate or change its default settings by writing certain AT commands in Arduino IDE. We can change its name and password using a serial monitor of Arduino IDE. Hc-05 is workable at a minimum 3.3v level for receiver and transmitter (Rx/Tx). It contains mainly four pins in it, one for providing voltage(3.3v or 5v) to it one for ground and the other two for receiver and transmitter. We have to define Rx and Tx pins through code and have to be implemented in the same pin otherwise compiler will show an error.

Figure 5.7: Bluetooth module

RFID Scanner: The scanner is usually based on Radio frequency identification technology. In RFID we have a scanner that receives a radio signal from RFID tags which are responsible for emitting the radio frequency wave. A small strip is present inside the tag which emits the radiofrequency. RFID has an advantage over Barcode that it can penetrate the object whereas the bar code needs to be scanned properly, so we can say RFID is much fast and convenient to use as well. It can store up to 2000 byte of data. The acronym refers to small electronic devices made up of a small chip and an antenna. The RFID sensor on the back of a credit card or ATM card serves the same purpose as a bar code or magnetic strip, providing that entity with a unique identifier. And just as you need to scan a bar code or magnetic strip to get the data, you need to scan the RFID system to get the identifying information. A major advantage of RFID devices over the others listed above is that it is not important to position the RFID sensor accurately relative to the scanner. Within a few feet (up to 20 feet for high frequency devices) of the scanner, RFID devices must operate. You could just put all your food or purchases in a box, for

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

example, and put the bag on the scanner. It would be able to immediately request all the RFID devices and complete your order.

Figure 5.8: RIFD scanner module

Battery: The battery is the power source that transforms chemical energy into electrical energy by chemical energy. We have used an HV battery of 5V which produces direct current electricity. For running motor drivers we use a power bank whose output is 8V when it gives vital power to the motor driver to run the wheels. This project is a prototype so we can use 12V of the source. But for real-life working mode, we require a high voltage supply to run the motors.

5.2 SOFTWARES USED:

Arduino Software: The Arduino software (IDE) is a software that is used to write the code into various Arduino boards and it runs on Linux, Windows, and OSX operating systems. Many other micro-controllers are limited to windows. For beginners, the Arduino Software (IDE) is simple to practice, yet stretchy enough even for sophisticated users to take benefit of. It is ideally focused for teachers on the Processing programming environment that will learn how the Arduino IDE operates. The Arduino code was released by professional developers as open-source tools, the language can be described through C libraries, and it can be easily understood by people.

Blynk App: Blynk is a platform that allows us to build an interface for controlling and monitoring our hardware projects from our iOS or Android devices. We simply to create project dashboard where we can arrange different widgets like Button, GPS, Slider, Timer, Joystick, LED, LCD, Terminal, Video Streaming, Twitter, Notification, Email,WebHook, Tabs, Menu, Table, Text Input, Numeric Input, Gravity Sensor, Light Sensor, Proximity Sensor etc. We need to provide the input button to different widgets as per its analog or digital connection. Blynk supports mostly Arduino Boards, Raspberry Pi, ESP8266, and other handfuls of common microcontrollers and single-board computers. We can connect our project to Blynk app via Bluetooth, Wi fi and different means.We use the Blynk app to give instructions to the project. We first create a project with Button, Bluetooth, LCD, and GPS module button and assign port digitally as well as analog as required. Assign different ports into the code as well. Once we

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

interface the port of the Blynk app with codes. Then we need to paired mobile Bluetooth with hardware Bluetooth to give instruction. Once both the devices get paired, Cart starts following to Blynk application.

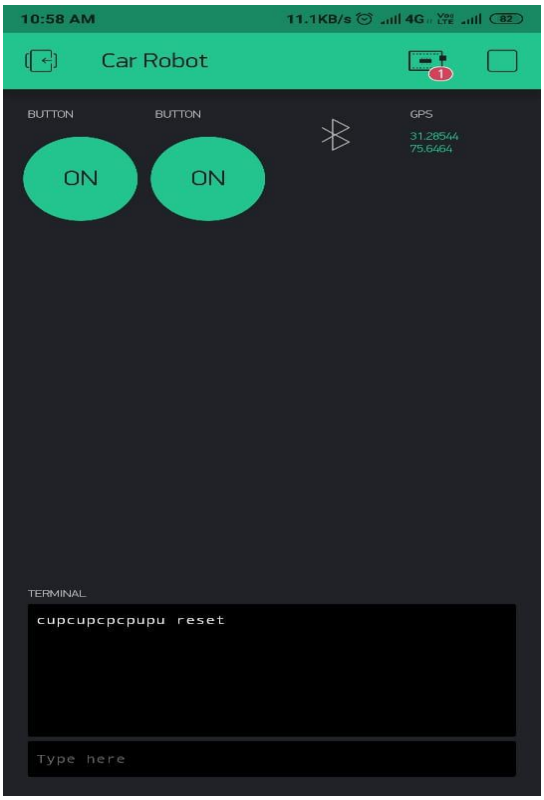


Figure 5.9: Blynk App interface

PLX-DAQ: It is the software that is used to interface the real-time data in the excel sheet. Parallax Data Acquisition tool PLX-DAQ add-in program for Microsoft Excel acquires up to 26 data channels from any Parallax microcontroller and falls the numbers into columns as they arrive. It provides an easy spreadsheet analysis of field-gathered data, sensor laboratory analysis and real-time monitoring of equipment.

5.3 HARDWARE IMPLEMENTATION:

1. At first as the customer enters a shopping mall, the cart gets started in 2 major ways, first, it gets connected to the mobile phone of the customer for the following the purpose and second, it gets connected to the database of the shopping mall.
2. The following module works as ArduinoUno(1) uses the various component to get connected to mobile such as; Compass, GPS, Bluetooth module with the help of the Blynk app of the mobile phone. And then the cart starts following the customer.
3. Now, the second major part is shopping: which works as: an RFID scanner is connected to ArduinoUno(2).

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

4. If data gets scanned by an RFID scanner, Arduino gives the command to the servo motor to open the flap to put the material inside of the cart.
5. The scanned data goes from Arduino(2) to Arduino Nano, which is connected with the help of Bluetooth modules.
6. The Arduino Nano is connected to the database(laptop) and then it updates the data saved in the Excel file.
7. Data saved in excel file is updated with real-time with a software called PLX-DAQ.
8. After the shopping is done, the total bill is displayed on the LCD. And after the completion user press, the done button and flap of cart get open.

5.4 DESIGN OF CART:

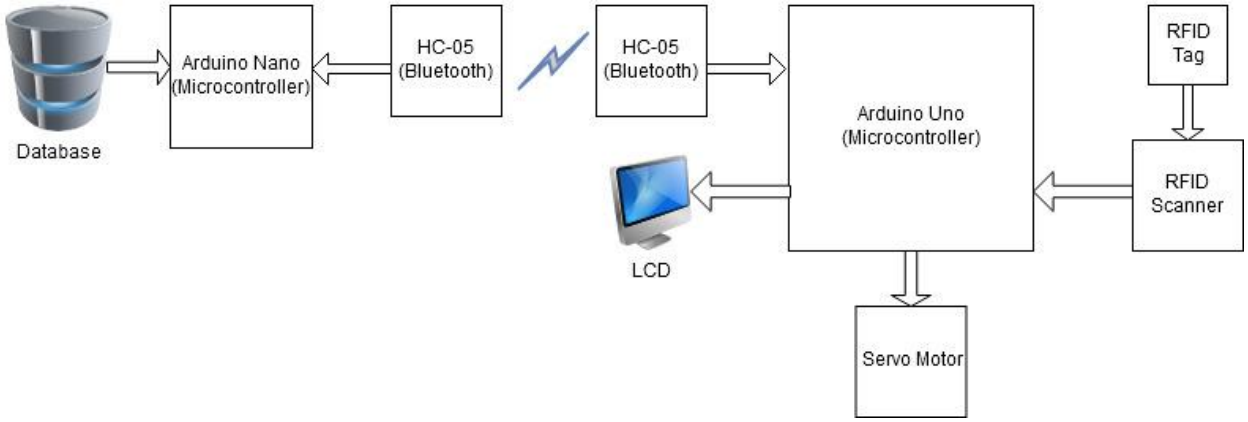
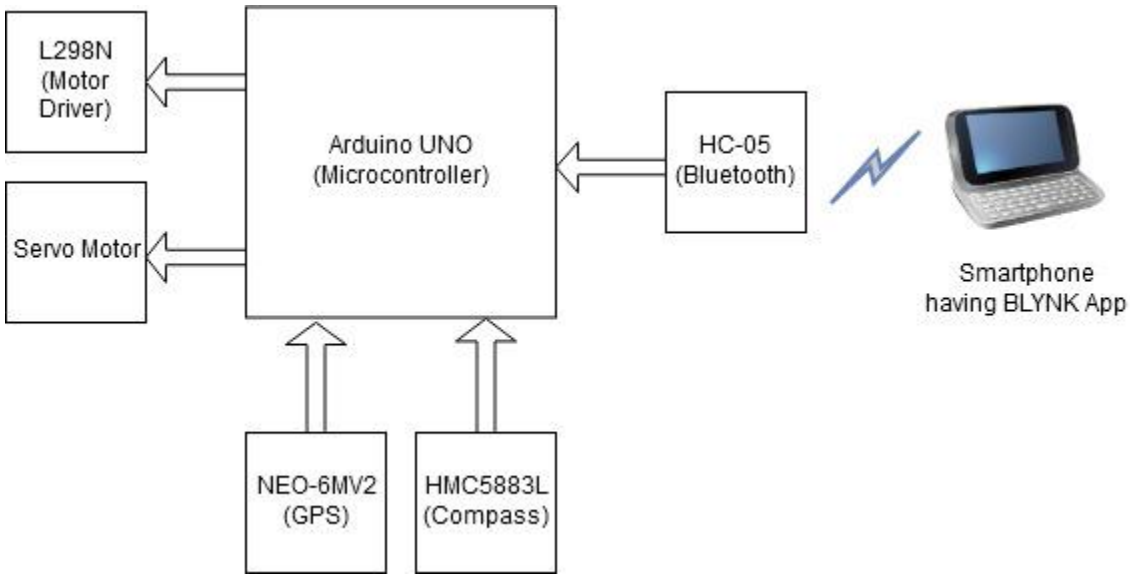


Figure 5.10: Database connectivity with cart



ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

Figure 5.11: Smartphone connectivity with cart

6. SYSTEM FLOW:

6.1: Flowchart:

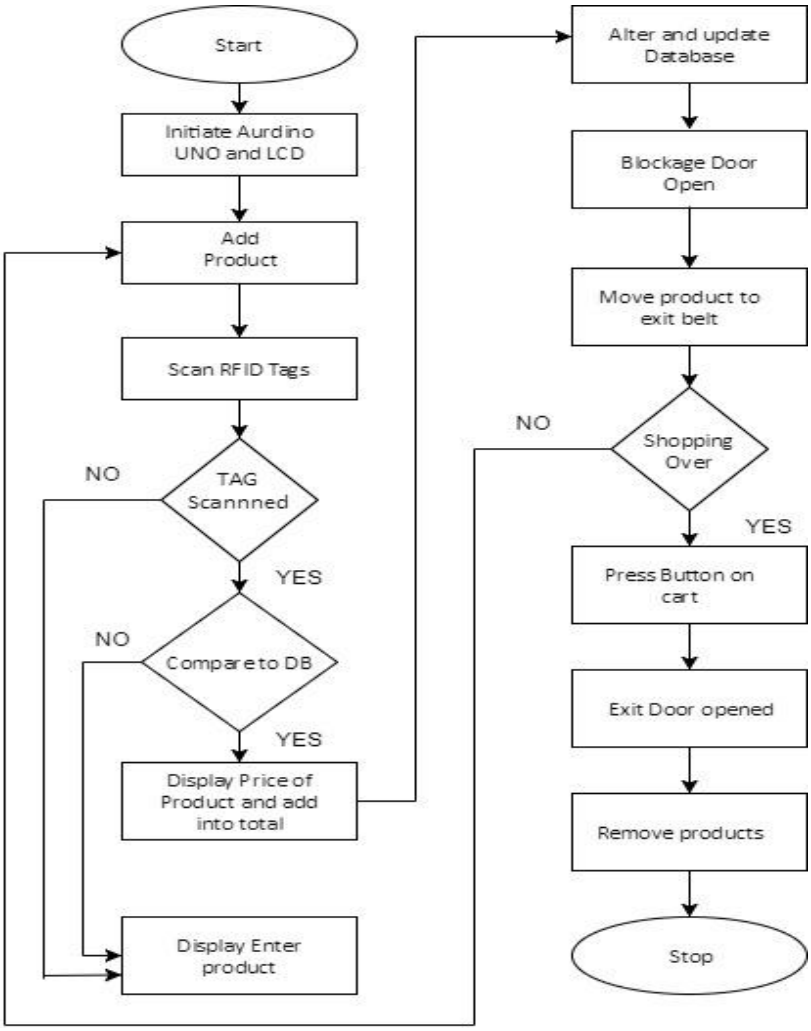


Figure 6.1: Control flow diagram

6.2 Algorithm:

Steps are:

1. Start
2. Initialize microcontroller and LCD.
3. Detect RFID tag code and compare with storedcode.
4. Add the price of the product to the total bill.
5. If any product is removed then the price will be subtracted from the total bill.
6. After pressing done button, The bill will hand over to the PC.

7. CENTRAL AUTOMATED BILLING SYSTEM

ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

The customer chose the item and he scans it with the RFID scanner, which is placed on the cart. This RFID scanner is connected to the Arduino Uno and which sends the data to the Arduino Nano with the help of Bluetooth. This Arduino Nano is interfaced with an Excel Sheet with the help of a software called PLX-DAQ, which updates the data present in the excel sheet with real-time sensing.

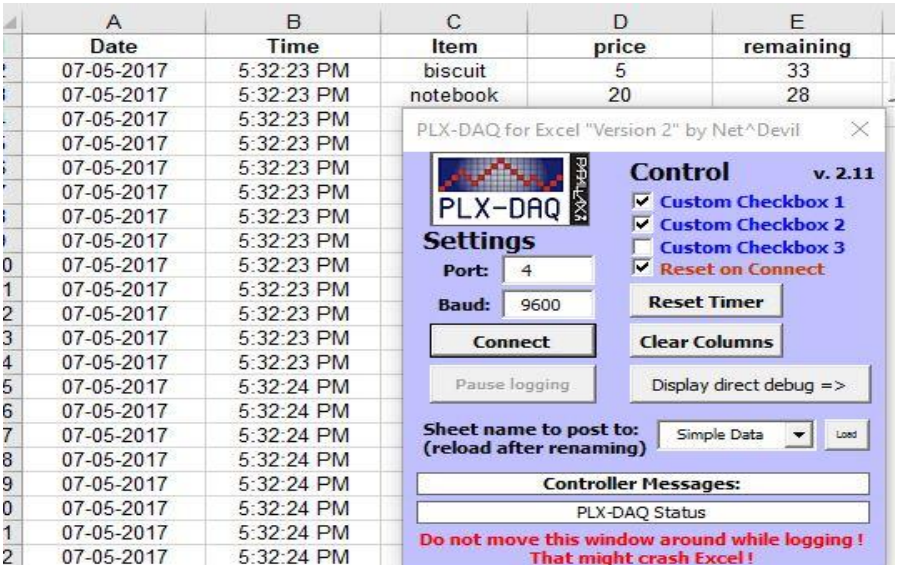


Figure 7.1: Interfacing of Arduino Nano with Excel sheet

After the shopping process is done, the total bill is shown on the LCD, which is placed on the cart. And after paying the bill, as the user press the done button, the flap of cart gets open and the user can take his material.

8. CONCLUSION AND DISCUSSION

After all our efforts we finally conclude that our smart shopping cart is based on making the shopping more easier, fast and private. This cart first needs to pair up with your smartphone device. Once it's paired, the cart is ready to go. The customer needs to put the product into its first cabin where RFID Scanner scans the RFID tag which sticks on the product and reflects the price on to the screen where it prepares the final bill once the customer ends their shopping. After making payment the exit door will open and the customer can remove their product. On the backend of every purchase, the item from the database gets reduced. This whole shopping experience is worth it when it gives you more priority and gives relaxation from a long boring queue. Customers need not submit or hand over their credit or debit cards to ensure more personal security as well. The main objective of the project is to make the shopping experience more exciting, easy, secure and fast. This project deals with every aspect of our objectives.

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ISSN: 0971-1260
Vol-22-NO-30 Special Issue-December-2019

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