International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.8, Issue.6, June 2020 E-ISSN: 2347-2693

Intelligent Trolley based on Internet of Things

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DOI: https://doi.org/10.26438/ijcse/v8i6.4044 | Available online at: www.ijcseonline.org

Received: 25/May/2020, Accepted: 20/June/2020, Published: 30/June/2020

Abstract— Every-day is a development of new technology and it creates a revolution in society. The Internet of things is used to combine many devices and communicate with each other to do a specific task. In this paper, we describe a smart system used in supermarkets or shopping malls. Smart trolley with RFID is used to facilitate the users and to know the amount of the purchased items in the trolley. The current system will scan and add the items using microcontrollers. In the existing system, there is a chance of theft activity or if the product does not scan properly and it creates a loss of data. To overcome the drawbacks we proposed a smart trolley with RFID, Arduino Nano, Node MCU esp8266, GSM module which will perform scanning, adding of items, removing of items and theft checking using a load cell and also sends a notification to the mobile user.

Keywords—Smart trolley, RFID reader, Arduino Nano, Node MCU esp8266

I. INTRODUCTION

The smart trolley using Node MCU esp8266, GSM module is based on IoT. The term Internet of Things is the interconnecting of devices and to communicate with each other to perform a specific task. In simple physical devices such as sensors, actuators will interconnect and send the information and receive the information. We proposed a system that consists of RFID tag, reader, microcontroller, IoT device and GSM module for sending messages or notification. This system provides an additional feature of checking the items using load cell using the weight of the items. In this cart, the system helps the customer to purchase the items and reduce the waiting time in the billing counter. This also helps to avoid theft activity. The Internet of Things plays a major role in this system. In section IV we discuss the clear methodology used for building the system and in section V we discuss the system architecture.

II. RELATED WORK

Rahul Chaudhari et.al proposed a system [2] that is developed using RFID and Arduino. Every product in the shop will be attached with an RFID tag and the information is fetched using RFID reader. It then passes the information to the database and will be given to the bill counter. The bill payment can be done online using smartphones. Invoices and offers also sent to the customers. In this paper, they also did analyze the stock and prediction methods for the future development of the shop. The main advantage is they planned to improve the quality of shopping by giving an enhancement of traditional billing system which will reduce the workload and manual errors in the billing system. They provided a system with automatic analysis, statistics, and prediction of future stock requirements.

K.Lalitha et.al proposed [13] a design of an intelligent shopping basket. They developed the system in which the barcode scanner will automatically detect the product when it is dropped into the basket. This is done using an ultrasonic sensor.

P.C. Warule et.al proposed a smart cart system [6] with mobile communication. The cart consists of RFID tags, RFID reader, Zigbee module, GSM module, load cell. Here in this system GSM module is used for mobile communication where the entire bill of the purchased items will be sent as a message to the customer phone. The Load cell is used for measurement of the weight of the items. If the items do not scan properly or there is some attempt of theft in the supermarket this load cell will detect it. In this system, they are also using IR sensor for counting the products which are used for the security purpose. In a situation someone removes the RFID tag and put the products in the trolley, then the counting process will perform the adding of the product cost and Product. They also used buzzer if the trolley is hacked. After purchasing, using the upload key the data will be sent to the counter. Using GSM it will send a message to the counter.

Prasiddhi K, Dhanashri H. Gawali proposed a system [3] that consists of microcontroller, LCD and RFID reader, keypad, Infrared add sensor, Infrared remove sensor, buzzer, RF transreciever module and power source. They developed a system with an RFID reader and LCD 16X4 will display other details or any notifications. This system

will help the customer to understand the use of the trolley. In this, the customer can set a budget using a 4X4 matrix keypad. The customer after purchasing items is equivalent to budget then buzzer buzzes and will give some notification. The two sensors are placed in the system to add the product items and to remove the product items if necessary. These sensors are placed at different levels. The adding sensor will work as up to down motion, similarly, the removing sensor will be working in vice-versa. The advantage of this project is that low cost to develop the system and it is convenient and user-friendly. It uses RFID and has high efficiency and security assurance is also more.

Mary Cherian et.al proposed [14] a system with smart billing using Raspberry Pi and RFID. This system is developed with automatic billing of products in the application for final billing and it can be accessed on mobile phones also.

Ankush Yewatkar et.al developed a system [5] in which every item in the shop will be attached with an RFID tag and each cart present in the shop will be attached with an RFID reader and Zigbee trans-receiver will be implemented on it. The payment process is controlled by a centralized server system. After each purchase, the cart should get automatically reset. The billing process will be done online. They also proposed a system, if the product is removed, the amount also be detected from it. They also provided a solution for antitheft, if in case the customer does not scan the product and try to steal it. To overcome this situation at the exit door, the RFID reader reads the tag and avoid anti-theft. In this system, they are displaying product information, expiry date. They also proposed an algorithm using the Bayesian network and ID3 (Iterative Dichotomiser 3) for improvement and efficiency.

Akshay Kumar et.al developed a shopping cart [12] using RFID, Arduino and Xbee module. The trolley is made with two Arduino Uno and two Xbee modules. In this system, one of the Arduino Uno is used for the cart and interfaced with LCD, Xbee and RFID reader which will read data from RFID tags and display the product details. The other Arduino Uno board is used for the purpose of storing and comparing the transmitted data. It also contains the database with Xbee connected with hardware. The advantage of using this system is that it has a feature of the deletion of products. If the customer does not wants the product and changes his/her mind or it is mistakenly scanned multiple times and it can be deleted using a push button. An advantage is that GPS system is used to know the exact spot of the products in the shop and display the current product is available or not.

P. Chandrasekar, T. Sangeetha proposed a system [4] which consists of Zigbee module, LCD display, RFID reader, EEPROM, RFID tag. The purchasing of items will be done using the RFID tag and the data will be read by RFID reader. Then the information will be stored in EEPROM. The information then sent to the bill counter from EEPROM using Zigbee module. It also accesses the database and it will perform the calculation operation of purchased items. They focus on the automated billing system. Using the identification device, the customer needs not to wait in queues for paying the bill in the bill counter. They also used inbuilt 12C protocol features for improvement in the efficiency of the system. The customer can pay their bills using credit or debit cards.

T.R.Lekhaa et.al proposed [1] a smart trolley using Bolt ESP8266, barcode scanner and LCD display. This system focus on the items that are scanned and put inside the trolley. The amount will be displayed on the LCD display. Then it can be sent to the bill counter after customer purchased the items. The main advantage is that the system is built with bolt esp8266 which is an updated version of IoT.

III. PROPOSED SYSTEM

The smart trolley is integrated with an RFID reader, LCD display, Arduino nano, Node MCU esp8266 and RFID tag. The RFID reader and other parts attached in the trolley. When the customer drops the product in the trolley, the RFID reader will scan and read the information. In case the reader does not scan properly or any theft activity happens the load cell will turn on the buzzer and the error message will be displayed in the LCD display. In this system, we are using RFID reader, Arduino nano, Node MCU esp8266, load cell and GSM module. The additional information of the component is given as follows.

A. Arduino

Arduino is one of the open-source computer hardware and software. It is the microcontroller-based kit. David Cuartilles and Massimo Banzi developed Arduino technology in the year 2005. The boards will be equipped with sets of digital and analog signals. The pins may be interfaced with various shields or breadboards. The example of the Arduino board is Arduino Uno. It includes an ATmega328 microcontroller and it has 28-pins. In this system, we are using Arduino Nano.

B. RFID Reader

It is an electronic device that reads the RFID tags which is the input. RFID tag stores the information and it can be fetched using RFID reader which identifies the objects quicker. The main use of this device is to read the information. Using radiofrequency waves RFID reader transfers the information wirelessly.

C. LCD

It is an electronic device with the properties of liquid crystals and polarizer which is used to display. The liquid crystal uses backlight and they do not transmit light directly for producing an image. In our system, we used 20x4 LCD to display the price of the items in which 4 rows and 20 characters can be displayed. Thus LCD is a flat

panel display and is also called as super-thin technology of smaller computers.

D. GSM

Global System for Mobile Communication is a module for transmitting data through digital cellular technology. The main use of GSM in this system is for sending messages of the product purchased. It can be accessed by SIM cards and provide high security by providing data encryption while sending the data. This module creates communication between smart cart and a mobile device.

E. Load Cell

The Load Cell we are using in this system is Strain Gauge. The main use in the weight of the items. So that there will be no product in the trolley without scanning. The load cell will measure the force in one direction.

F. NodeMCU ESP8266

It is an open-source development kit and it is considered as an IoT platform to build IoT product which interconnects all the devices. It can be used easily and it can be programmed using Arduino IDE.

IV. METHODOLOGY

A. Reading Process

The product which is attached with an RFID tag in it it will be scanned by RFID reader. The information is stored in the RFID tag is fetched using an RFID reader. It is interfaced with Arduino nano which is a microcontroller that performs the functions required to build this system.

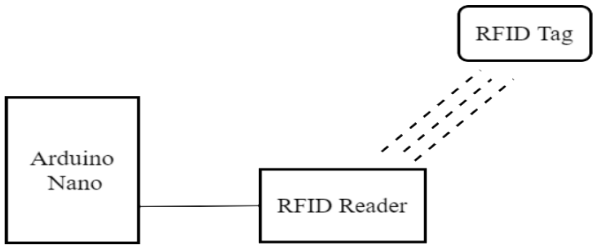

Figure 1. Interfacing RFID reader with Arduino Nano

B. Displaying Process

In this module, it will perform the adding of items and removing items using a button and code to perform the operation. After every product added or deleted the current bill will be updated as a bill in the LCD display.

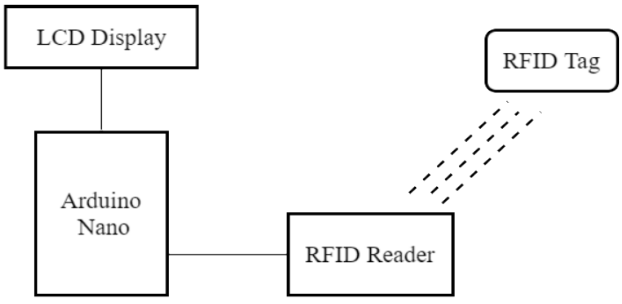

Figure 2. Interfacing Arduino with LCD display

C. Checking Process

In this module, we developed a system for a situation where the product is not scanned properly or any theft activity it will perform its operation. The load cell of 10 kg is attached in the trolley it will check while every insertion there is an increase in weight and it matches with the trolley. If not it will turn on the buzzer and display the error message in the LCD display.

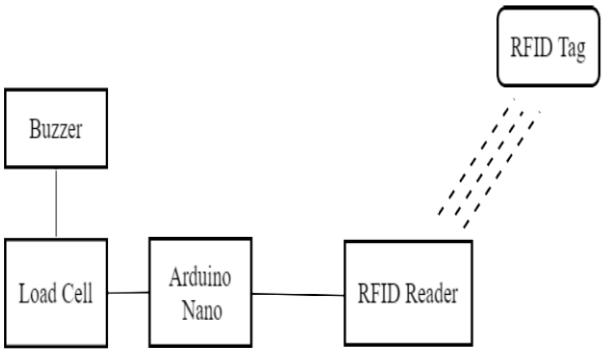

Figure 3. Interfacing RFID, Arduino, Load cell and Buzzer.

D. Transmitting Process

In this module, there are two-phase, where it transmits the data to the PC in the bill counter and a message is sent to a respective mobile user using GSM. The trolley has a unique number for identification and it will be connected to the local server in the supermarket. After pressing the ok button it will transmit the information. Sending messages or notification is an additional feature in this system.

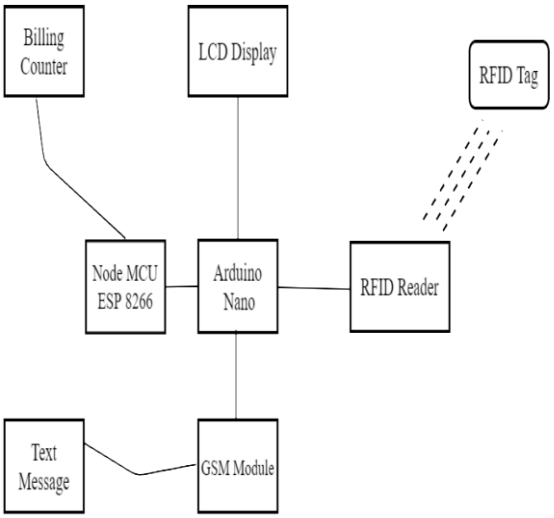

Figure 4. Transmitting data to the billing counter and Sends Message

V. SYSTEM ARCHITECTURE

Finally, the architecture for the smart trolley is given with the process of interfacing the RFID reader, Node MCU esp8266, Arduino nano, GSM module, LCD display as

well as the required code needed to perform the operation. In the front end, the user will scan the product and observe the information in the LCD. In the backend, it will process all the functions and transmits the data to the bill counter and sends a notification to the bill counter.

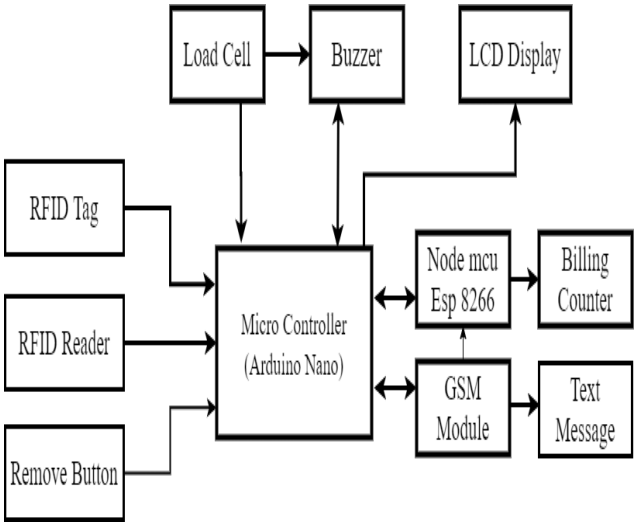

Figure 5. The Architecture of the proposed system

A. System Description

Every product will be attached with an RFID tag and the data in it will be read by RFID reader [MFRC522]. To consider the input RFID tag and buttons. To consider the output LED display, PC monitor. The information read by the RFID reader will be given to the Arduino Nano. Where the required code is attached to perform the specific adding and removing operation. The load cell will check the weight of the product with the weight in the trolley. If it does not matches it will switch on the buzzer and the error message will be displayed in the LCD 20*4 display. Node MCU ESP8266 IOT device is placed to interconnect all the devices. Then the information will be sent to the billing counter using a local server. Using the GSM module the message will be sent to the mobile user. If the customer misses any product the mobile user can inform them.

B. Algorithm

Step 1: Start.
Step 2: Select the product.
Step 3: Read data with the RFID reader.
Step 4: Display data on LCD.
Step 5: To detect whether the product scanned properly or not and to avoid theft Load cell is used.
Step 6: Display error message.
Step 7: Update product cost if added.
Step 8: Remove button used for product deletion.
Step 9: Press the ok button to end shopping.
Step 10: Bill is passed to Bill counter.
Step 11: Message will be sent to the respective mobile user using GSM.
Step 12: End.

C. Dataflow Diagram

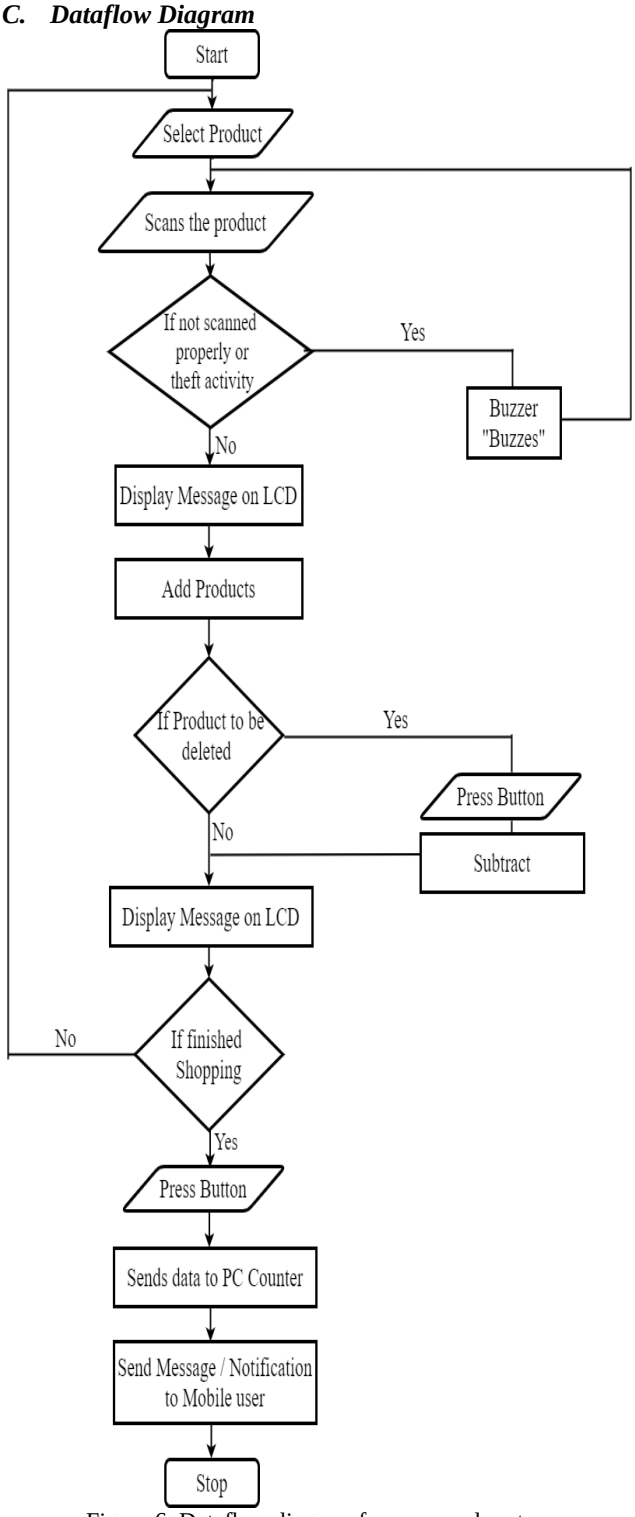

Figure 6. Dataflow diagram for proposed system

VI. CONCLUSION

The smart trolley used in the supermarket is a new trend and it creates customer shopping easier. The main aim of the proposed system is to reduce the waiting time in the billing and to reduce the number of salesmen present in the billing counter. This system is built with devices that are interconnected together using IoT. The added advantage of

using this system is it will check the products using the load cell. If the weight does not match with the weight in the trolley, then the buzzer will turn on and the error message will be displayed in the LCD display. The next feature is that after finishing shopping customers will press the ok button and a message will be sent as a notification to the mobile user using the GSM module. If the customer even misses any products the mobile user will update about it. Thus this system makes the customer enjoy a better shopping experience with intelligent working.

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