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SMART TROLLEY WITH AUTOMATED BILLING SYSTEM

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Abstract - *The main objective is to enhance the shopping experience of the customers and to reduce their time, waiting in the bill counters and also to reduce the burden of the customers from pushing the trolley manually, we have introduced a remote control system to control and move the trolley. From traditional methods of pushing the trolley, picking up the purchase materials manually and standing in Billing section queue for a long time is a tedious process. Our project overcomes these difficulties encountered today in real time, by automating these processes overall. The main problem encountered here is the billing process. It is made easy by instant billing, whenever a product is added or removed from the trolley. Another problem that we encounter is pushing the trolley, which enables physical stress and also may lead to formation of traffic, when a considerable amount of customers are roaming over the same department. We, in our project have automated the process and the trolley by itself has the ability to move instead of pushing it manually. Thus, our proposed project may cause a significant growth in this field, thereby reducing the physical stress and also manpower.*

Key Words: Arduino UNO, Trolley, Barcode Scanner, Driver circuit, DC motor, etc…

1.INTRODUCTION

In today's world, time is more important than anything else. Therefore our primary objective is to save time wasted by people in avoidable circumstances. One such situation is waiting in billing section counters. Since the bill total is done here by scanning the purchased items one by one, it takes awful lot of time to total one customer's bill. This leads to customers spending their precious time in queues waiting for long durations. To overcome this problem we have come up with an innovative idea of smart billing system i.e. totalling the cost of all the simultaneously while shopping. For this we have attached separate bar code scanner in each trolley which enables the customer to scan the product while selecting itself, the cost of the product gets added to the total. An IR sensor has been fixed to count the total number of productsincase of any discrepancy. The added feature of this trolley is to able to move it using a remote thus reducing the manual work of pushing it, it greatly helps elderly people who cannot push heavy trolleys. Overall this smart trolley with automatic billing system is a boon to save time and reduce manual work.

The total of the cost of the items is displayed in the LCD display fixed in the trolley. It has two modes namely 'in' and 'out' mode. IN mode is for putting the items inside the trolley and OUT mode is taking out the unwanted items.

1.1 Research Background

It was also found that shopping trolleys are always scattered around everywhere inside or outside supermarkets. Scattered trolleys can roll away from its position and collide with people, thus injuring them. A woman was killed by a runaway trolley when she exited the escalator. There was another case where a loaded runaway trolley caused a woman to die from her injuries and injured her husband in a shopping center.

4.1ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter. Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers.

Fig -1.1: Arduino Board

2.1 FEATURES ·

Microcontroller: ATmega328P ·

Operating voltage: 5V ·

Input voltage: 7-12V ·

Flash memory: 32KB ·

SRAM: 2KB ·

EEPROM: 1KB

3. BARCODE SCANNER

A bar code reader (or bar code scanner) is an electronic device that can read and output printed barcodes to a computer. Like a flatbed scanner, it consists of a light source, a lens and a light sensor translating for optical impulses into electrical signals. Additionally, nearly all barcode readers contain decoder circuitry analyzing the bar code's image data provided by the sensor and sending the barcode's content to the scanner's output port.

3.1 PEN TYPE SCANNERS

Pen-type readers consist of a light source and photodiode that are placed next to each other in the tip of a pen. To read a bar code, the person holding the pen must move the tip of it across the bars at a relatively uniform speed. The photodiode measures the intensity of the light reflected back from the light source as the tip crosses each bar and space in the printed code. The photodiode generates a waveform that is used to measure the widths of the bars and spaces in the bar code. Dark bars in the bar code absorb light and white spaces reflect light so that the voltage waveform generated by the photodiode is a representation of the bar and space pattern in the bar code. This waveform is decoded by the scanner in a manner similar to the way Morse code dots and dashes are decoded.

Fig -1.2: Barcode Reader

4. IR SENSOR

Infra red sensors are the most often used sensor by amateur roboteers. Understanding how they behave can help address many of your requirements and would suffice to address most of the problem statements for various robotics events in India. Be it a typical white/black line follower, a wall follower, obstacle avoidance, micro mouse, an advanced flavor of line follower like red line follower, etc, all of these problem statements can be easily addressed and granular control can be exercised upon your robots performance if you have a good operational understanding of Infra red sensors.

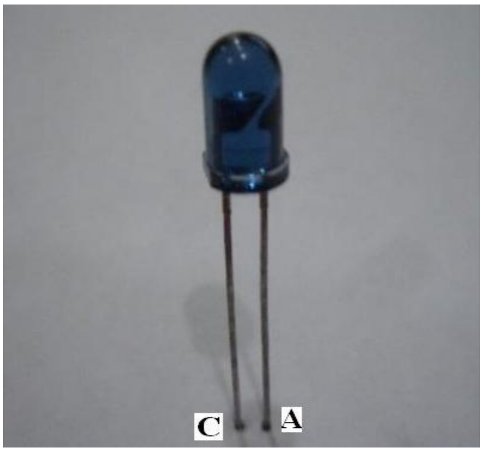

Fig -1.3: IR Module

2.1 Construction of IR module

Infra red sensors are in the form of diodes with 2 terminals. You can buy a pair of such diode (one transmitter and one receiver) at a very low cost of about 5 - 7 rupees only. Here onwards, we will use Tx to refer to a transmitter and Rx to refer to a receiver diode.

When the Tx is forward biased, it begins emitting infra red. Since it's not in visible spectrum, you will not be able to see it through naked eyes but you will be able to view it through an ordinary cell phone camera.

Fig 1.4 : A typical transmitter circuit

.The resistance R1 in the above circuit can vary. It should not be a very high value (~ 1Kohm) as then the current flowing through the diode would be very less and hence the intensity of emitted IR would be lesser. By increasing the current flowing in the circuit, you can increase the effective distance of your IR sensor. However, there are drawbacks of reducing the resistance. Firstly, it would increase the current consumption of your circuit and hence drain the battery (one of the few 'precious' resources for any embedded system) faster. Secondly, increasing the current might destroy the Tx. So, the final choice should be a calculated trade off between these various factors.

You can also modulate the IR to achieve better distance and immunity.The receiver diode has a very high resistance, typically of the order of mega Ohms when IR is not incident upon it. However, when IR is incident upon it, the resistance decreases sharply to the order of a few kilo Ohms or even lesser. This feature forms the basis of using IR as a sensor. You will need to connect a resistance of the order of a few mega Ohm in series with the Rx. Then tap the output voltage at the point of connectivity of these two resistors.

5 LCD DISPLAY

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi

segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

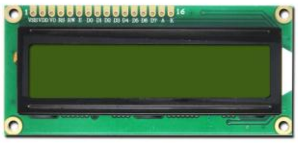

Fig 1.5: LCD Display

6 DRIVER CIRCUIT

The ULN2003 is a monolithic high voltage and high current Darlington transistor arrays. It consists of seven NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diode for switching inductive loads. The collector-current rating of a single Darlington pair is 500mA. The darlington pairs may be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED gas discharge), line drivers, and logic buffers.

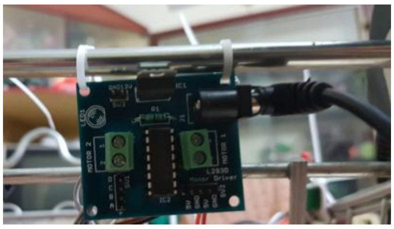

Fig 1.6: Driver Circuit

The ULN2003 has a 2.7kW series base resistor for each Darlington pair for operation directly with TTL or 5V CMOS devices.

6.1FEATURES

* 500mA rated collector current (Single output)
* High-voltage outputs: 50V
* Inputs compatible with various types of logic.
* Relay driver application

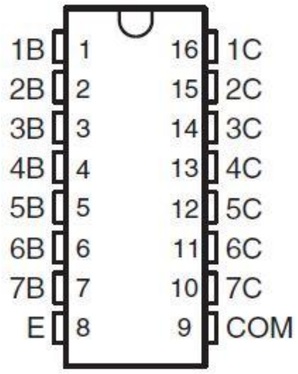

Fig 1.7: Pin Configuration of Driver Circuit

7 DC MOTOR

A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homopolar motor (which is uncommon), and the ball bearing motor, which is (so far) a novelty.

By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source—so they are not purely DC machines in a strict sense.

We in our project are using brushed DC Motor, which will operate in the ratings of 12v DC 0.6A which will drive the flywheels in order to make the robot move.

Fig 1.8: DC Motor

8 EXISTING SYSTEM

Now a day purchasing and shopping at big malls is becoming a daily activity in metro cities. We can see huge rush at malls on holidays and weekends. It seems too hectic to push the trolley till entire shopping is done and after that customer have to wait in the queue for billing. To overcome these issues or to ease this we are proposing our project, in which customer need not to concentrate on the movement of trolley as Trolley will move automatically following the sensors. Not only this, our trolley will have the RFID reader so that customer can keep track of billing.

Fig 1.9: Image of an existing trolley

8.1 BLOCK DIAGRAM OF EXISTING SYSTEM

Our project deals with the day to day scenario of shopping in supermarket, nowadays every supermarket has a trolley which is used just to place allthe selected items in it and to push those to the bill counter. The existing trolley is used just to push all the items.

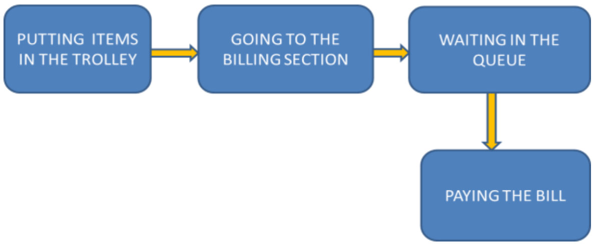

Fig 1.10: BLOCK DIAGRAM OF EXISTING SYSTEM

8.2 DRAWBACKS IN EXISTING SYSTEM

- In existing system , the trolley is only used to keep all the items to be purchased and pushed to the billing counter
- There is no facility to scan the item using barcode reader.
- There is no Infra Red sensor to count the total number of items purchased
- We cannot calculate the total bill amount before going to the bill counter

9. PROPOSED SYSTEM

Our proposed system is an advanced version of trolley. We have fitted several additional features like counting the total number of items using IR sensor, scanning the barcode of the product using the barcode reader to estimate the cost of the product. The total cost of all the items scanned can be estimated .

Fig 1.11: Image of Proposed System

A buzzer is fitted incase if someone tries to cheat the shop owner by putting the items in the trolley without actually scanning it in the barcode, the buzzer is programmed in such a way that , it will go off if a product is dropped into the trolley without scanning with the barcode, but if the customer had actually dropped the product by mistake, then the customer has to call for assistance and then turn the buzzer off.

9.1 BLOCK DIAGRAM OF PROPOSED SYSTEM

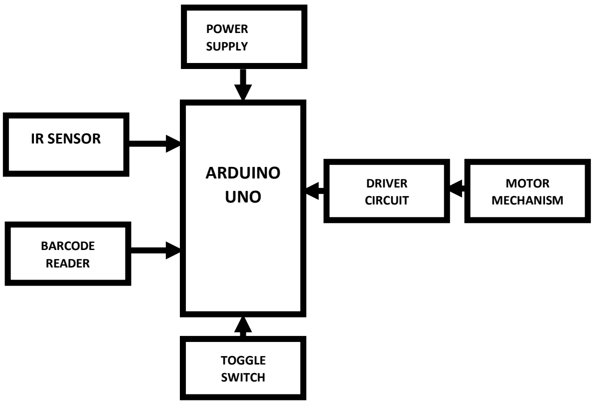

Fig 1.12: Block diagram of our proposed system

As the existing system of trolley is merely used for pushing the items alone, we have come up with an idea of using it to minimize the waiting time of customers in the long queues in billing section.

9.2 FLOW CHART OF OUR PROPOSED SYSTEM

The given flowchart clearly describes the flow of the process. The process basically involves two operations namely adding and deducting the selected items, so we have to choose the mode with which we are going to operate first. On selecting the mode, we can continue with either adding or deducting the items. In 'IN' mode the items are added, first the selected item is scanned in the barcode reader then it is detected by the IR sensor fixed at the side of the trolley. The LCD display displays the name and cost of the scanned product also the total cost of all the scanned products is also shown in the display thereby enabling the customer to know total hand by hand. In 'OUT' mode, the customer can deduct the cost of unwanted items by first detecting it in the IR sensor and then scanning it with the barcode. The cost of the scanned item gets deducted from the total cost.

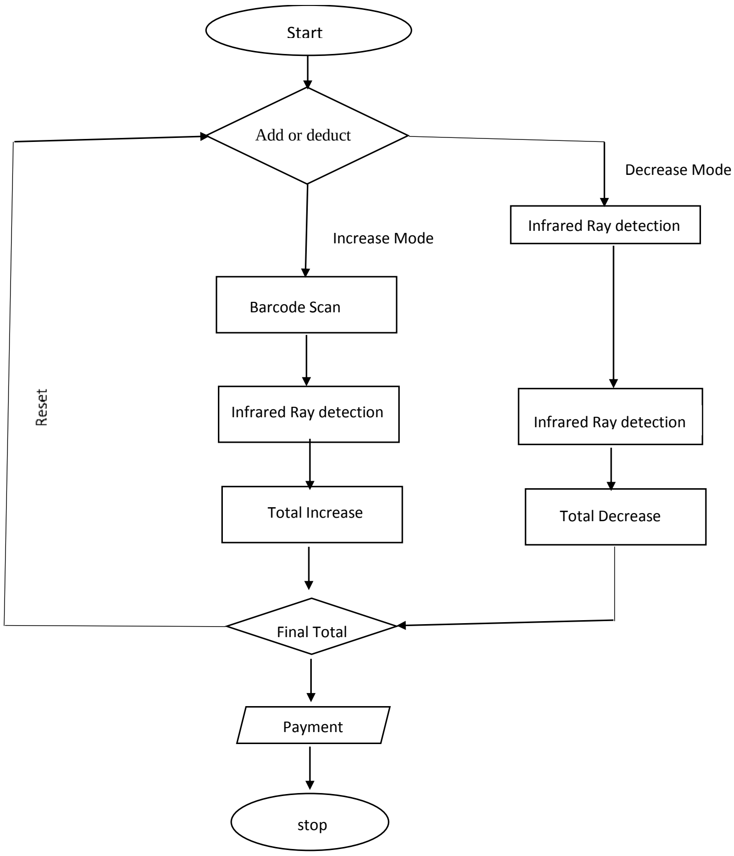

Fig 1.13: Flow chart of our proposed system

10. TOGGLE SWITCH

In this proposed project we've two types of modes.
(i) In Mode
(ii) Out Mode

Toggle switch is used to switch modes between 'In' to 'Out'

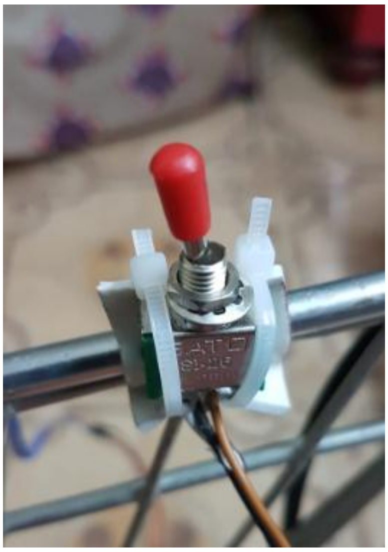

Fig 1.14: Toggle switch

The table given bellow shows the working function of the toggle switch for our proposed system.

Table -1: Toggle switch working

WORKING OF THE TOGGLE SWITCH		
Right	IN MODE	This mode indicates that products are ready be added inside the trolley.
Left	OUT MODE	This mode is used to reduce the products from the trolley.

11. SOFTWARE REQUIREMENTS

EMBEDDED C
ARDUINO IDE

EMBEDDED C
ABOUT EMBEDDED C

High-level language programming has long been in use for embedded-systems development. However, assembly programming still prevails, particularly for digital-signal processor (DSP) based systems. DSPs are often programmed in assembly language by programmers who know the processor architecture inside out. The key motivation for this practice is performance, despite the disadvantages of assembly programming when compared to high-level language programming.

If the video decoding takes 80 percent of the CPU-cycle budget instead of 90 percent, for instance, there are twice as many cycles available for audio processing. This coupling of performance to end-user features is characteristic of many of the real-time applications in which DSP processors are applied. DSPs have a highly specialized architecture to achieve the performance requirements for signal processing applications within the limits of cost and power consumption set for consumer applications. Unlike a conventional Load-Store (RISC) architecture, DSPs have a data path with memory-access units that directly feed into the arithmetic units. Address registers are taken out of the general-purpose register file and placed next to the memory units in a separate register file.

A further specialization of the data path is the coupling of multiplication and addition to form a single cycle Multiply-accumulate unit (MAC). It is combined with special-purpose accumulator registers, which are separate from the general-purpose registers. Data memory is segmented and placed close to the MAC to achieve the high bandwidths required to keep up with the streamlined data path. Limits are often placed on the extent of memory-addressing operations. The localization of resources in the data path saves many data movements that typically take place in a Load-Store architecture.

The most important, common arithmetic extension to DSP architectures is the handling of saturated fixed-point operations by the arithmetic unit. Fixed-point arithmetic can be implemented with little additional cost over integer arithmetic. Automatic saturation (or clipping) significantly reduces the number of control-flow instructions needed for checking overflow explicitly in the program.Changes in technological and economic requirements make it more expensive to continue programming DSPs in assembly. Staying with the mobile phone as an example, the signal-processing algorithms required become increasingly complex. Features such as stronger error correction and encryption must be added. Communication protocols become more sophisticated and require much more code to implement. In certain markets, multiple protocol stacks are implemented to be compatible with multiple service providers. In addition, backward compatibility with older protocols is needed to stay synchronized with provider networks that are in a slow process of upgrading.

Today, most embedded processors are offered with C compilers. Despite this, programming DSPs is still done in assembly for the signal processing parts or, at best, by using assembly-written libraries supplied by manufacturers. The key reason for this is that although the architecture is well matched to the requirements of the signal-processing application, there is no way to express the algorithms efficiently and in a natural way in Standard C. Saturated arithmetic.

For example, is required in many algorithms and is supplied as a primitive in many DSPs. However, there is no such primitive in Standard C. To express saturated arithmetic in C requires comparisons, conditional statements, and correcting assignments. Instead of using a primitive, the operation is spread over a number of statements that are difficult to recognize as a single primitive by a compiler.

Embedded C is designed to bridge the performance mismatch between Standard C and the embedded hardware and application architecture. It extends the C language with the primitives that are needed by signal-processing

12. EMBEDDED C PORTABILITY

By design, a number of properties in Embedded C are left implementation defined. This implies that the portability of Embedded C programs is not always guaranteed. Embedded C provides access to the performance features of DSPs. As not all processors are equal, not all Embedded C implementations can be equal For example, suppose an application requires 24-bit fixed-point arithmetic and an Embedded C implementation provides only 16 bits because that is the native size of the processor. When the algorithm is expressed in Embedded C, it will not produce outputs of the right precision.

In such a case, there is a mismatch between the requirements of the application and the capabilities of the processor. Under no circumstances, including the use of assembly, will the algorithm run efficiently on such a processor. Embedded C cannot overcome such discrepancies. Yet, Embedded C provides a great improvement in the portability and software engineering of embedded applications. Despite many differences between performance-specific processors, there is a remarkable similarity in the special-purpose features that they provide to speed up applications.

Writing C code with the low-level processor-specific support may at first appear to have many of the portability problems usually associated with assembly code. In the limited experience with porting applications that use Embedded C extensions, an automotive engine controller application (about 8000 lines of source) was ported from the eTPU, a 24-bit special-purpose processor, to a general-purpose 8-bit Freescale 68S08 with about a screen full of definitions put into a single header file. The porting process was much easier than expected. For example, variables that had been implemented on the processor registers were ported to unqualified memory in the general-purpose microprocessor by changing the definitions in the header definition and without any actual code modifications. The exercise was to identify the porting issues and it is clear that the performance of the special-purpose processor is significantly higher than the general-purpose target.

13. CONCLUSIONS

Our project of **SMART TROLLEY WITH AUTOMATIC BILLING SYSTEM** has performed well and the results shows it.
It reduces the precious time of the customers waiting in the long billing queues. This system will be most useful during festive times as the crowd in the shops is usually more during that time.

We can improve this project by replacing high range IR sensors and also by placing ball wheel at the front end of the trolley to improve the movement of the trolley. In future the LCD display can be replaced by an GUI, which will greatly increase its usage by adding several other features like displaying the total layout of the supermarket so that the shoppers can easily identify the location of the products.

LIST OF ABBREVATIONS

IR	Infra-Red
IC	Integrated Circuit
LCD	Liquid Crystal Display
CMOS	Complementary Metal Oxide Semiconductor
RFID	Radio Frequency Identification
LED	Light Emitting Diode
EPC	Electronic Product Code
PID	Product Identification Device
EEPROM	Electrically Erasable Programmable Read only Memory
PMOS	Positive Metal Oxide Semiconductor
MAC	Multiply-Accumulate Unit
GUI	Graphic User Interface

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