

Design and erection of several stockpile sorting system based on radio frequency identification (RFID)

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ABSTRACT Automated sort-based machines can consistently run up to the same value of at the same repetitive pace, reducing the chance of injury or, worse, an accident. To automate inventory placement tasks, Radio Frequency Identification (RFID) technology is used to identify, store, collect, and transmit. The proposed system can uniquely identify material and equipment types and facilitate cost-effective solutions for tracking them almost instantly. Today, increasing the attributes and reliability of products and services is a must for all manufacturers. Automated sorting systems play an essential role in ensuring that goods and products are properly organized and distributed across different industries. The primary assignment performed here is to sort the items fabricated in the organization. Having a place with any segment in robotization has a significant job and commitment towards proficiency, adequacy, and decreasing the human blunder to a base degree. Automation plays a significant role in control systems to minimize human errors and their contributions. Industries of developing countries have already implemented this concept. That is why they get their time used adequately during their production period and export products after fulfilling their native demands. In our country, we also have some industries which have started mass production with miscellaneous products. But due to lack of automation in placing segment, they run behind from the target of maximum profit. With the implementation of this project in those industries, they can minimize their time loss for placing and reduce the loss of time during loading products in the vehicle for the desired destination.

Keywords : Automated, Sorting, Radio Frequency Identification, Microcontroller, Arduino

1. Introduction

Improvement in the assembling part relies on different investigations in the assembling procedure and development of innovation in a new item. High manufacturing and production rates determine who will be a developed country. In this cutting-edge world, automation assumes a significant job in the improvement. In perspective on the essentials, any industry makes materials of different sizes, and it will not be monetarily functional if the division is done physically. Work cost, human exertion, and odds of human mistake will increment in this procedure of arranging. To overcome these disadvantages, automation plays a significant role which makes it economically feasible and timesaving. Sorting should be possible from various perspectives like arranging of an item as indicated by their dimensions (height, length, thickness, etc.), as characterized by their hues, as per their weight, utilizing machine vision (mage handling), as per the material of an article, and so forth. Radio Frequency Identification (RFID) solves those entire problems by using an electromagnetic field between antenna and tag, enabling automatic acquisition of data for identification without direct contact. RFID is being implemented in the industrial sector, mainly supply chain implementation is the most general RFID application. RFID streamlines and computerizes resource checking as well as dispenses with the likelihood of a human mistake. Every benefit or labeled thing is distinguished and recognized consequently, and it is coordinated with the correct data in the database utilizing its one-of-a-kind ID. This enables makers to keep up an exact stock of every labeled resource and

appropriately represent current resources and future store network, arranging, or gear needs. Producers now understand the agility, exactness, and capacity benefits from automated sorting machinery brings to the production line.

Sorting is significant in industry, for example, producing sector, to improve the effectiveness of assembling forms. Modern mechanization manages the improvement of vitality effective drive frameworks by exact estimation and control innovation. Automation reduces human errors. The cost of design layout and the power involved increases with complex architecture in an automated system. Human efforts reduce by evolving with these technologies. It provides more time to work on different methods and aspects. Life risks to humans minimize the implementation of automation when made to work in hazardous conditions [2].

Deshmukh et al., 2016 [3] developed the conveyor system for sorting color-based objects. They used microcontrollers and color sensors for determining the type of colors.

Kumar & Mandloi, 2013 [4] expressed the survey of belt transport plan execution and about current advancements utilized in different industrial applications to minimize upkeep cost, disappointments, and gear-related mishaps activity.

Kumar B S et al., 2015 [6] discussed the productivity improvement using buffer conveyor systems in tobacco industries. Buffering implies the capacity to gather items that can be conveyed at an unexpected rate in comparison to what is gotten. They also introduced advancement through Gravity Roller transport for weight decrease, and it is intended for a higher factor of

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security. By this study, monitoring the conveyor speed in optimizing the production of the machines and conveyors becomes concretely solvable.

Radio-Frequency Identification (RFID) portrays a traditional term for late developments that make usage of radio waves to fathom and catch information assemble on a tag or names attached to an article to be perceived. Radio-recurrence distinguishing proof (RFID) uses electromagnetic fields to know the all-inclusive community or articles. A mark can be recognized up to a couple of partitions away and shouldn't be inside the direct perceptible pathway of the peruse to be followed [7].

Cardoso et al., 2016 [8] studied a traveler acknowledgment framework utilizing Radio Frequency Identification (RFID) innovation - EPC Gen2 standard - in open vehicle frameworks. This investigation assessed various labels and reception apparatuses arrangement methods, considering a few positions where the clients often convey an RFID card.

Zhu & Li, 2018 [9] investigate the RFID peruse arranging issue to versatile reconnaissance articles whose movement can be anticipated. He further proposes a few peruse putting methodologies to deal with RFID impacts in the surveillance.

Kumari, Leena, et al., 2015 [10] give peruses a diagram of ongoing usage of RFID in a different portion of Agri-sustenance part together with the obstructions hampering its wide appropriation. Essentials of RFID tag, including identification, recurrence ranges, and norms accessible for information transmission, are likewise examined.

Zacharewicz et al., 2011 [11] examine the advancement of a recreation stage because of Generalized Discrete Event Determination (G-DEVS) models and HLA (High-Level Architecture) standard. The proposed arrangement is connected with a cargo transportation framework. It copies the conduct of the different parts (RFID coupled to movement and versatile innovation) required to upgrade the item's directing.

Automated sorting-based machines can consistently carry through the same repetitive pace to the identical value, reducing the prospect of injuries and, even worse, accidents. The objectives of this project are given below: (i) To design and fabrication RFID based sorting system. (ii) To reduce the utmost work cost. (iii) To limit the manual work to reduce the human errors and increase their safety. (iv) To improve efficiency of the sorting system. (v) To use maximum space of any storage

2. Methodology

2.1 Project design

Reviewing the project scope and research area is the first step before the implementation of this project. Designing the mechanical structure of the sorting system is the next step. If all the form has been settled, the usage of the equipment and the circuit happens. The programming segment takes place to complete the

project, especially for the sensor process and output to the motors in the mechanism. Finally, modifications to the circuitry and software took place to make the system perform more delicate movements. When the whole process completes, then a fully operational plan will be achieved. In this mechanism, the conveyor belt will start running with the help of a dc motor; when the system starts, when the product passes through the conveyor belt, the RFID tag reader will scan the tag attached to the product. Then the product will go into the lift after crossing the conveyor belt. The lift will then take the effect to its desired floor, which is already programmed. A push mechanism will push the product to its storage. Arduino will control the entire system. RFID will help to identify objects. This block diagram summarizes the entire methodology. It is used to understand the whole process briefly.

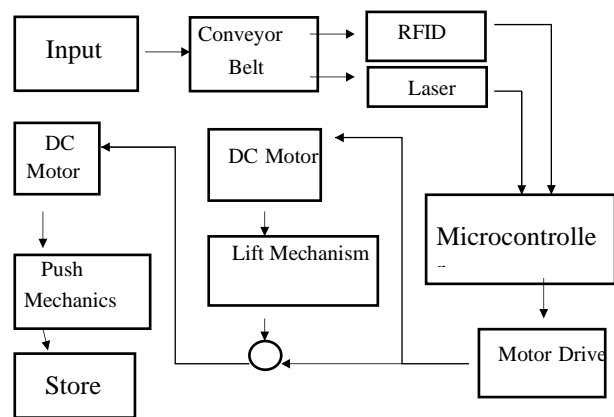


Figure 1 : Block Diagram of Shorting System

3D view has been used to easily understand the structure of the project.

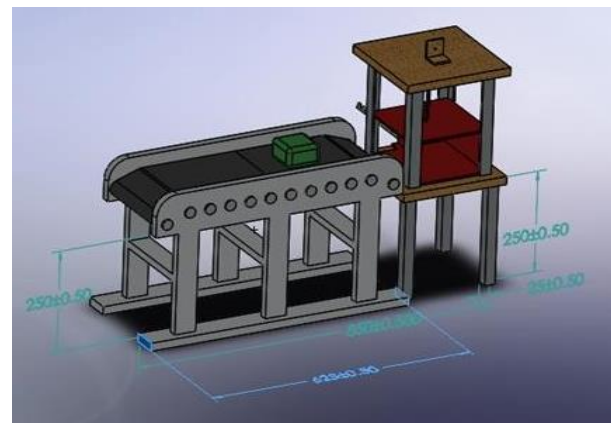


Figure 2 : 3D view with dimension

The conveyor belt can be utilized for moving substantial material at a long separation. However, this undertaking will be structured thinking about lightweight and little break. The arranging framework may most likely sort the items as indicated by their tag. Just a three-storied structure will be utilized in this framework. Fault in any section will stop the system outcome

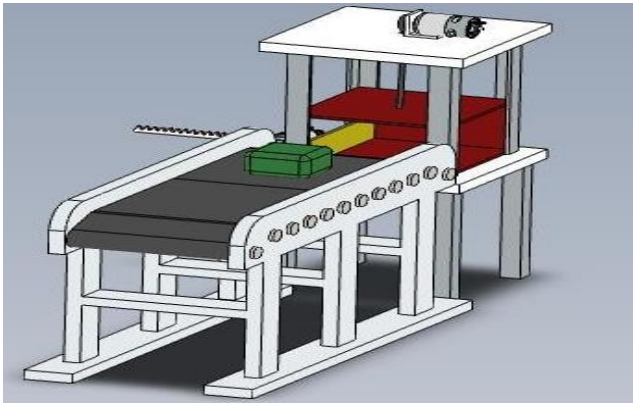


Figure 3 : 3D view (front side)

2.2 Basic Component

2.2.1 RFID model

RFID frameworks are firmly like smart cards. Information is put away on electronic communication conveying gadgets. Be that as it may, in contrast to the keen card, the power supply to the information transferring gadget and the information trade is accomplished without the utilization of galvanic contacts. However, utilizing an attractive or commonplace RFID framework appears in Fig.4.4. The specialized methodology is drawn from radio and radar designing because of the various favorable circumstances of RFID electromagnetic fields. They are beginning to conquer systems differentiated and other distinctive verification structures. RFID frameworks are a new mass market.

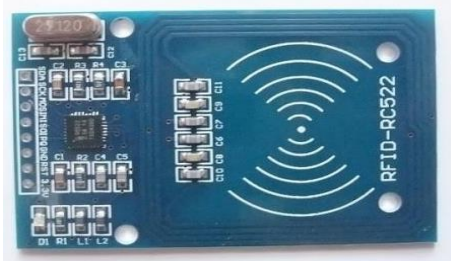


Figure 4 : RFID Module

2.2.2 RFID tag

RFID marks are used in various endeavors. For instance, an RFID name joined to a vehicle during the creation can be utilized to watch its headway through the progressive advancement structure. RFID-named drugs can be done in dissemination centers, and embedded RFID computer chips in prepared animals and pets draw in particular check of creatures. Since RFID marks can be joined to cash, clothing, and resources or installed in animals and people, the probability of examining Figure



Figure 5 : RFID Tag

eventually associated information without consent has raised certifiable security concerns.

Figure

2.2.3 ARDUINO Uno

The Arduino Uno is a microcontroller board dependent on the ATmega328. It has 14 computerized info/yield pins (of which six can be utilized as PWM yields), six simple information sources, a 16 MHz fired resonator, a USB association, a power jack, an ICSP header, and a reset catch. It contains everything expected to help the microcontroller; essentially, interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin. The Uno and adaptation 1.0 will be the reference variants of Arduino. The Uno is the most recent progression of USB Arduino sheets and the reference model for the Arduino stage.



Figure 6 : Arduino uno

2.2.4 Breadboard

A breadboard is an improvement base for the prototyping of devices. Since the solderless breadboard doesn't need restriction, it is reusable. Breadboard simplifies it to use for making temporary models and investigating various roads in regards to circuit structure. Thus, solderless breadboards are moreover notable with understudies and in mechanical preparation. More settled breadboard types didn't have this property.

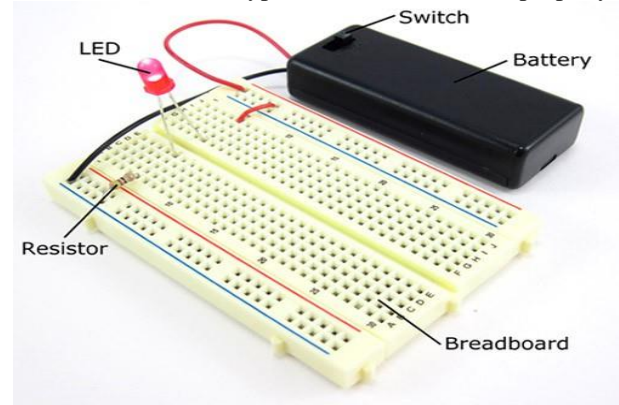


Figure 7: Breadboard.

2.2.5 Connector

Connector An electrical connector is an electro-mechanical gadget joining electrical circuits concerning an interface utilizing a mechanical get-together. Connectors comprise attachments (male-finished) and jacks (female-finished). Concerning versatile hardware, the association might be brief, require an instrument for

gathering and evacuation, or fill in as a changeless electrical joint between two wires or gadgets. A connector can be utilized to unite different connectors successfully.



Figure 8 : Connectors

2.2.6 USB power supply

USB power supply is another important element.



Figure 9 : USB Power Supply

2.2.7 Battery

A battery will be used to rotate the motors.



Figure 10 : 12-volt battery

2.2.8 Stepper motor

A stepper motor, otherwise called a staged engine or venturing engine, is a brushless DC electric engine that partitions a complete revolution into various equivalent advances. The engine's position would then be instructed to move and hold at one of these means with no position sensor for input (an open-circle controller), as long as the engine is deliberately measured to the application to torque and speed.



Figure 11: Stepper motor

2.2.9 DC motor

A DC motor is a merely fluctuating electric engine fueled from the immediate flow, as appeared in Fig.12. The stator is stationary in space by definition and accordingly is current. The current in the rotor is switch by the commutator additionally be fixed in the area. This is how the relative edge between the stator and rotor attractive transition is kept up almost 90 degrees,

which the most extreme torque. The enlistment of DC engines to run apparatus wiped out the requirement for neighborhood steam or inward ignition motors and line shaft drive frameworks. DC engines can work straightforwardly from battery-powered batteries, giving the rationale capacity to the principal electric vehicles. Today DC engines are found in applications as little as toys and circle drives or in considerable sizes to work steel moving factories and paper machines.



Figure 12 : DC Motor

2.2.10 Conveyor belt

A vehicle line is the passing on the system of a belt transport structure (routinely condensed to belt transport). A belt transport framework is one of the different kinds of vehicle structures. A belt transport structure includes at any rate two pulleys (to a great extent suggested as drums), with an endless hover of passing on medium—the vehicle line—that turns about them. Power can be added to both pulleys, and it will help to move the belt. The pulley which can be controlled is called a drive pulley, and the unpowered pulley is called an idly pulley. There are two basic present-day classes of belt move; Those when all is said in done material dealing with, for instance, said moving boxes along inside a preparing plant and mass material managing. For example, those used to move colossal volumes of advantages and green materials, such as grain, salt, coal, mineral, sand, and overburden, are just a hint of something larger.



Figure 13 : Conveyor belt

2.2.11 Bearing

A bearing is a machine component that forces relative motion only to the ideal movement and reducing the grinding between moving parts.



Fig 14 : Bearing

The bearing plan, for example, may be compatible with the free direct development of the moving element or with the expectation of an appreciative revolution around a particular center. It can fight against a movement by controlling the general energy vectors carrying in moving parts. Most direction encourages the ideal activity by restricting rubbing. Positioning is grouped comprehensively as per the sort of actions, the movements allowed, or the bearings of the heaps (powers) attached to the parts.

2.2.12 Wooden base

It is the base where the whole setup will stand.

3. Construction of Sorting System

3.1 Working principle : Different types of motions, control systems, sensor and power supply need to be studied to fabricate an automatic multi-storage sorting system with a conveyor belt.

At first, a wooden structure has been made. After that, a circuit has been constructed to control the movements of the conveyor belt, lifting mechanism, pushing mechanism. So, there are mainly three sections to build the whole project. They are: Mechanical Section , Electrical Section, Controlling Section

3.2 Basic Structure



Figure 15 : Wooden Structure (Top View)



Figure 16 : Wooden Structure (Front View)

3.3 Circuit The circuit diagram is simulated in proteus software.

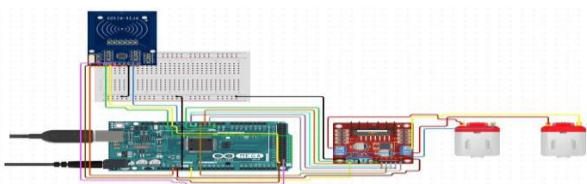


Figure 17 : Circuit Diagram

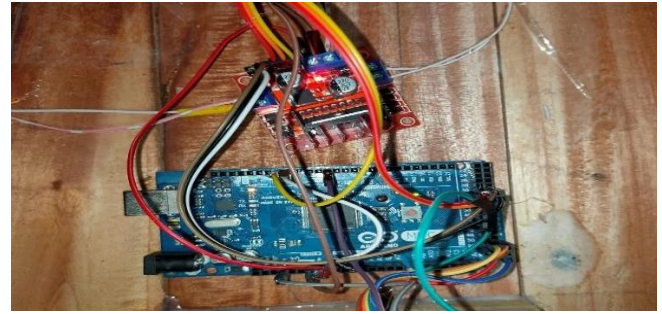


Figure 18 : Circuit

3.4 Final Setup



Figure 19 : Camera view of the project

4. Cost analysis

The cost of this sorting system is very low compared to the conventional sorting system. Used RFID tags can be reused, which helps in reducing the total cost. The setup cost of the system is also relatively low to the conventional sorting system. The essential components and corresponding approximate prices are listed below:

Table 1: List of prices of different component

No	Components	Price (TK)
01	Microcontroller	700/=
02	12V 300rpm DC Motor (2 Pc)	800/=
03	12V 50rpm DC Motor (1 Pc)	400/=
04	12V 2A Power Adapter	100/=
05	Motor Mount & Hex Coupler	340/=
06	L298(G) Motor Driver (2 Pc)	400/=
07	RFID Module, Tag	200/=
08	Belt	50/=
09	Oscillator, Resister, Wires, Switch, Breadboard	510/=
10	Screws	120/=
11	Linear Actuator	300/=
12	PVC Pipe	50/=
13	Aluminum Pipe	30/=
	Total	4000/=

5. Conclusion

This project is concerned with the minimization of time loss for placing to its particular place. Industries, where mass productions occur have a considerable beneficiary effect of this time loss where these placements are done manually. In summation, time loss per product brings significant loss in chronological production, whose monetary value is noticeable in their annual profit estimation. Engineering aspects introduce technical implementations to reduce such losses. That's what my project is concern about. By submitting this concept in industries with mass production, we can get a huge benefit. This project introduced various products at their desired place using motors, sensors, and microcontrollers. So industries with different products can get the beneficiary effect from this concept also. So with the implementation of the idea in sectors, the annual profit can be maximized to a great extent.

6. Recommendation :

The effectiveness of this project can be improved by following this recommendation: i) Additional power can be included in the absence of mains. ii) The limited motor power limits the mechanical structure, and a heavy construction can be obtained by incensing force to have a more thoughtful look & more effective control. iii) Sorting by every way of dimension can be done by some modification. iv) By improving the sensor quality, sorting can be done more accurately. v) Decreasing time delay can make the process fast.

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NOMENCLATURE

- P : Powder, W
V : Voltage, V
L : Length , cm
S : Speed, rpm