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Design and Fabrication of Solar Robotic Trolley for Material Handling

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ABSTRACT:

Material handling robot for multi stations is a mobile robot used in industrial applications to move materials around a manufacturing area or a warehouse. Proximity Sensor, DC Motor, Wheel and Material handling vehicle are the main blocks in this project. Here we use proximity sensor to handle a material and to replace it at a particular place in for our requirement. For this purpose we use visitor guided vehicle. A motor is attached with the vehicle wheel for moving purpose. The motor gets power through control unit. The proximity sensor detects the positioning plate and gives the output signal to the control unit and it activates the relay. The motor runs when the relay is on. When the vehicle reaches a particular place the reader detects and alarm is activated.

Keywords: Material Handling Robot, Solar Panel, Arduino Lm 328, HC05 Bluetooth, Proximity sensor.

I. Introduction:

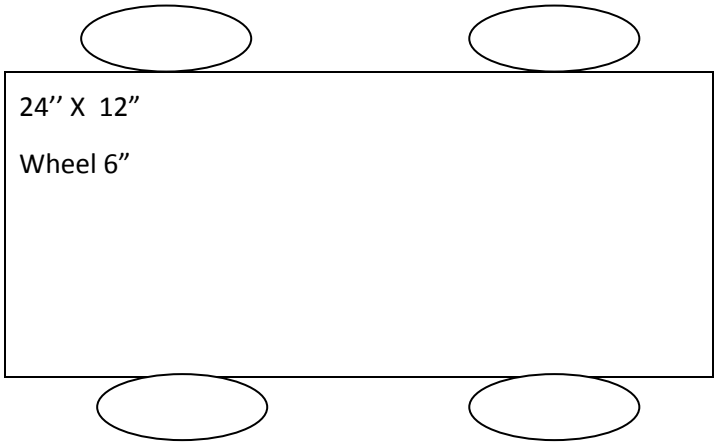
Material handling is the essence of industrial robotics with most robotic applications falling within this category. End-users deploy robots to improve throughput, quality, flexibility and consistency while decreasing ergonomic hazards for workers, scrap and the need for additional conveyance systems in manufacturing and warehouse distribution centers. Robots are increasingly called on to handle material ranging from blood samples to entire vehicles during the manufacturing process. “Consumers are more cautious about consistency and quality. Market demands change daily and the ability to adapt to changes in products and packaging is essential,” says Shishir Rege, Packaged Goods Product Marketing Manager at the Motoman Robotics Division of Yaskawa America Inc. (Miamisburg, Ohio). “Manufacturers need adaptability for mass customization so they invest in robotics to become more efficient. Robotics help in quick changeovers from one product to the next can handle a high mix of products and adjust to throughput demands.”Material handling is a series of methodologies that we employ to control the transfer of materials or components from process to process. It can also be adapted to be a process, such as a walking beam, that locates and transfers with high precision, such that a process may be superimposed on single or multiple stations. A traditional dial table would fall into this category.

II. LITERATURE SURVEY

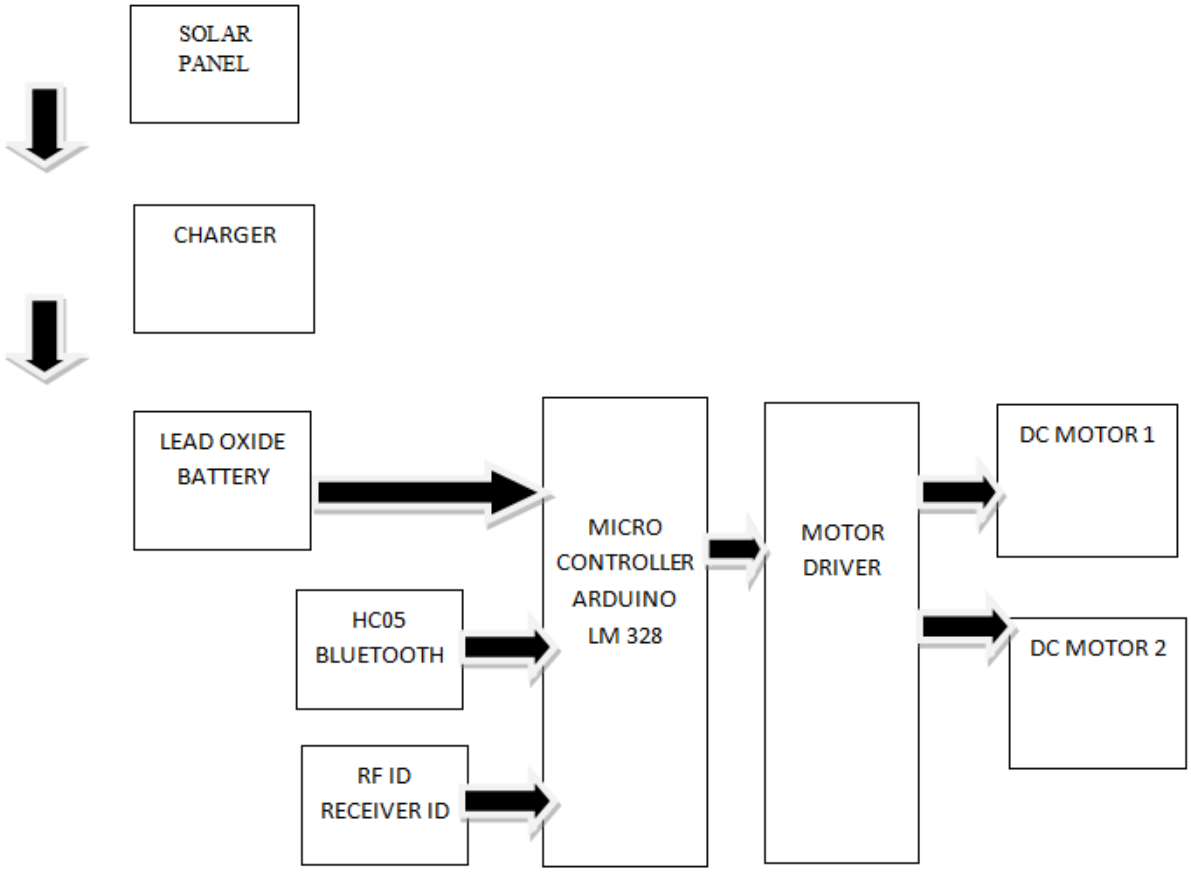
Production lines and assembly lines are referred to as material handling systems. The material handling is the movement, storage of materials and products throughout the process of their manufacture, assembly and distribution. Broadly material handling is a system that does the material handling ope Deepak K, Vivek S and Anand S [2], Comfort coupled with safety and simplicity is what man strives for. This project has been to bring about both .The culmination of their effort has resulted in development of a new Design & fabrication of flexible conveyor. The project present a basic as well as very professional treatment of the subject in a very comprehensive, based on learning effort and understanding capability of today as per their levels. The device is simple and comfortable. The salient features ofthis machine can be listed as the mechanism used is very simple, easy for operation; no skill is required to operate the machine.

Amit S, Inayattulla K, Salim B and Pandurang V [3], The rations. Conveyor is one of the systems used in industries. The aim of this project is to design and develop a conveyor system, which should work only when an object is placed on it and count the number of objects passed on it. Also a feature is added in this system that the number of objects to be handled is programmed, thus the conveyor works only for the programmed number of objects

Figure.1. Trolley



II.BLOCK DIAGRAM



III. DESIGN

The primary considerations for designing the gear drive used were those of space and availability. Thus we have adopted the reverse engineering approach i.e. we first purchased the gears and using the parameters known to us we calculated the safe load that can be lifted by the Trolley.

Power of motor = 17W

Pressure angle, α = 20 deg full depth involute

Number of teeth on pinion, Z_1 = 10 teeth.

Number of teeth on gear, Z_2 = 18 teeth.

Speed of the pinion, n_2 = 100 rpm.

Module, m = 5 mm.

Gear and pinion are made of cast steel C-20 (heat treated material).

Transmission ratio,

$$I = \frac{Z_2}{Z_1} = \frac{18}{10} = 1.8$$

Diameter of pinion, $d_1 = m\times Z_1 = 5\times 10 = 50$mm.

Diameter of gear, $d_2 = m\times Z_2 = 5\times 18 = 90$mm.

$\tan\delta_1=1/i$

$\delta_1=\tan^{-1}[1/1.8]=29.05^0$

$\tan\delta_2= i$

$\delta_2=60.95^0$

virtual number of teeth,

$Z_{vp}=Z_1/\cos\delta_1=10/\cos 29.05$

=11.44 teeth

$Z_{vg}=Z_2/\cos\delta_2=18/\cos 60.95$

=37.07 teeth

lewis form factor,

$y_p=0.154-(0.912/Z_{vp})$

$=0.154-(0.912/11.44)$

$=0.0742$

$y_g=0.154-(0.912/Z_{vg})$

$=0.154-(0.912/37.07)$

$=0.1294$

Gear and Pinion is made of cast steel C-20 heat treated, σ_d=191.295mpa

$\sigma_d y_p=14.194$

$\sigma_d y_g=24.7535$

Pinion is weaker so, the further design is based on pinion.

$y=y_p\times\pi$

=44.591mm

$v_m=\pi\ m\ Z_P\ n_p/60000$

$v_m=\pi\times 5\times 10\times 180/60000$

= 0.4712 m/sec

Service factor, c_s

Consider the shock to be steady shock and type of service as 3hr/day, c_s=0.8

$M_{t1}=(9550\times N)/n_p$

$=(9550\times 17)/180=901.944$ N-mm

$R=(m/2)\times\sqrt{((Z_1\times Z_1)+(Z_2\times Z_2))}$

$=(5/2)\times\sqrt{((10\times 10)+(18\times 18))}$

=51.478mm

Let b=R/3 $\Rightarrow$ 17.16mm $\approx$ 18mm

Velocity factor,

c_v=5.5/(5.5+v_m)

=0.921

Dynamic load,

v_m=0.4712 m/sec

f = 0.0912

c = 600.4

$f_d = f_t$+[(21$v_m \times (f_t + bc)$)/ (21v_m+ $\sqrt{(f_t + bc)}$)]

=36.077+[(21 $\times$ 0.4712 $\times$ $(36.077 + (18 \times 600.4))$)/(21 $\times$ 0.4712+ $\sqrt{(36.077 + (600.4 \times 18)}$)]

f_d =36.077+(107296.32/114.03)

=977N

Hardness 450,

K=3.9662mpa

Q= $((2 \times Z_2)/(Z_1 + Z_2))$

=1.285

f_w=50 $\times$ 18 $\times$ 1.285 $\times$ 3.9662

=4586.91N

f_w/ f_d = 4.69 [$\therefore$ design is safe]

Weight that can be lifted by the jack,

f_t=w $\times$ p/2 π R

w=(36.07 $\times$ 2 $\times$ π $\times$ 25)/6

w=944.3N

=96.259kg

IV.CONTROL

Here we used blue tooth technology to control the robotic

FIGURE.2. HC05 BLUETOOTH

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate)3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

4.1 Bluetooth Module HC-05

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device, but can accept connections. Master module can initiate a connection to other devices. The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.

4.2 Hardware Features:

- Typical -80dBm sensitivity.
- Up to +4dBm RF transmit power.
- 3.3 to 5 V I/O.
- PIO(Programmable Input/Output) control.
- UART interface with programmable baud rate.
- With integrated antenna.
- With edge connector.

4.3 Software Features:

- Slave default Baud rate: 9600, Data bits:8, Stop bit:1,Parity:No parity.

- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:"1234" as default.

4.4 PIN DESCRIPTION:

The HC05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate When enable is left open or connected to 3.3V, the module is enabled i.e the module remains on and communication also takes place.

Vcc:

Supply Voltage 3.3V to 5V

GND:

Ground pin

TXD & RXD:

These two pins acts as an UART interface for communication

STATE:

It acts as a status indicator.When the module is not connected to / paired with any other bluetooth device,signal goes Low.At this low state,the led flashes continuously which denotes that the module is not paired with other device.When this module is connected to/paired with any other bluetooth device,the signal goes High.At this high state,the led blinks with a constant delay say for example 2s delay which indicates that the module is paired.

BUTTON SWITCH:

This is used to switch the module into AT command mode.To enable AT command mode,press the button switch for a second.With the help of AT commands,the user can change the parameters of this module but only when the module is not paired with any other BT device.If the module is connected to any other bluetooth device, it starts to communicate with that device and fails to work in AT command mode.Pin Description

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate.When enable is left open or connected to 3.3V, the module is enabled i.e the module remains onand communication also takes place.Vcc: Supply Voltage 3.3V to 5VGND: Ground pinTXD & RXD: These two pins acts as an UART interface for communicationSTATE:

It acts as a status indicator.When the module is not connected to / paired with any other bluetooth device,signal goes Low.At this low state,the led flashes continuously which denotes that the module is not paired with other device.When this module is connected to/paired with any other bluetooth device,the signal goes High.At this high state,the led blinks with a constant delay say for example 2s delay which indicates that the module is paired.

V. MICRO CONTROLLER ARDUINO NANO LM 328

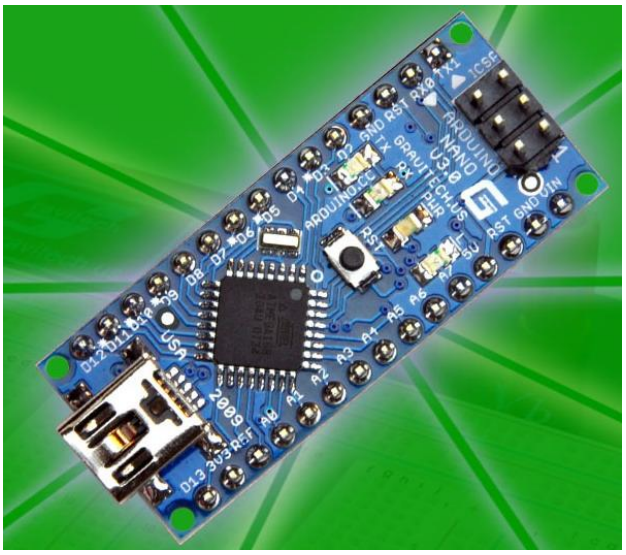


FIGURE.3. ARDUINO NANO LM 328

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, Max MSP).

Arduino received an Honory Mention in the Digital Communities section of the 2006 Ars Electronica Prix Credits.

5.1 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!

5.2 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"

5.3 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

5.4Power:

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.

VI. RESULTS AND CONCLUSION

6.1 RESULTS

The results which we obtained after implementing the project proved the same. Automation of the scrap disposal system (trolley), there is an advantage of low running cost, reduced time cycle and increased precision. The set timers and limit switches in the system help self alignment of the trolley and in turn avoid the mixing of burrs. The age is automation driven and that is what makes the scope of this project quite high. This system can be implemented in any company where disposal of waste or for that matter any kind of material segregation, is a major concern. The above system is implemented and run.

6.2 Conclusion

With soaring healthcare costs, paid days off, vacation time, and other costly employee benefits, companies can save money with industrial automation. Manual operated Scrap Disposal System involved manual errors which reduced the accuracy and increased the wear and tear of the machine parts. While robotic machinery can initially be extremely expensive we have reduced the running cost of the system considerably. While machinery used for industrial automation can break down, it does not happen often. If it does only a handful of maintenance running smoothly again. Additionally, the automation of Scrap Disposal System has led to reduced time cycle of the disposal process. As per the statistics, time cycle for one particular type of scrap disposal has come down by more than 10%. The scrap that is generated is recycled into raw material for casting process. Thus, reduced time cycle leads to faster rate of scrap disposal which ultimately helps enhance the productivity of raw material. An improvisation of this system automation can be at the finishing end of a production line which manufactures more than one type of product and needs separate storage for the same. For instance, any production company requires mass storage of Type C materials, which are the materials that require least maintenance and are usually ordered in large numbers. Segregation of such materials is an important factor since it will reduce the fetch time and enable smooth functioning of the company without any unnecessary delays.

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