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Design and Methodology of Line FollowerAutomated Guided Vehicle for Material Handling

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Abstract

Advancement of automated/computerized guided vehicle assumes a noteworthy part in designing businesses to enhance the material taking care of procedure for late year. In this paper, it is focus on the design and different methodology of line follower automated guided vehicle (AGV) systems. This paper provides an overview on line follower AGV discusses recent technological developments. The essential components of line follower robot and their modification are described in this paper.

Keywords:

Material handling;
Automation;
Line follower agv;
AGV.

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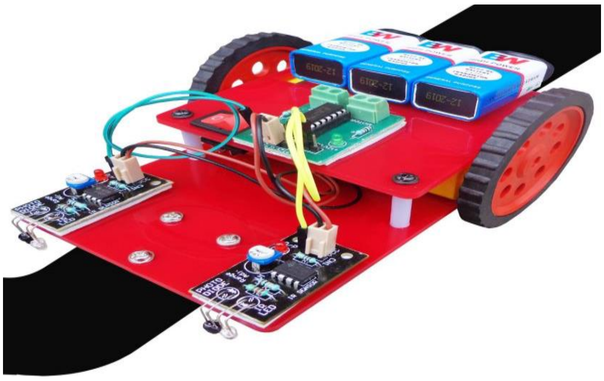
I. INTRODUCTION

With the technological advancement in the field of machineries, there have been various attempts to improve the material handling techniques. AGV (Automated Geared Vehicle) is one of the remarkable machine which helps in various tasks such as fork lifting objects, towing, product transportation etc., without the continuous monitoring of human. An AGV works with the simultaneous processing of various parts. The control gadget which is basic to both the driving gadget and exchange gadget works the vehicle and keeps up a definitive procedure of robotized guided vehicle. Nearness sensors are set up to identify the vehicle development which specifically controls the begin and stop procedure of Agv. Photo sensors are joined to recognize the material or protest in the station.A material exchange framework incorporates stacking and emptying of material through the arrangement of particular gadget, in which the electrical associations are interconnected. The first AGV developed by A.M.Barnet (1953) who used overhead wire to navigate the vehicle in grocery shop. The utilization of Agv's developed colossally since their presentation, the quantity of territory of use and variety sort has expanded fundamentally. Recently AGV extended their popularity to other application. Depak punithe (IJRAS august 2013) developed an AGV to betterment public health care system. We can use AGV as serving robot in hotel, material handling robot in warehouse and improve the health care system. Manufacturing area Agv are proficient to transport all kinds of material identified with assembling process.According to Gotte (2000) the usage of AGV will pay off for manufacturing environment (like distribution, transportation, and transshipment) with repeating transpiration pattern. He described different available technology for automation in container terminal. The control gadget receives signals from the exchange gadget once transferring gets finished and transmits signals to the driving framework to move the vehicle to the following goal pointAs per the stream way, the hued tape technique is most appropriate for this vehicle for best result. The best stream way is planned considering all perspectives. It is a battery controlled vehicle in which it charges consequently.Inductive power exchange techniques were executed in the vehicle to improve better executionAlthough, most of the AGVs use some mark or defined path to move on, works are going on to develop such an AGV having artificial intelligence which can be dynamic in the sense of navigation and whose locomotion is not limited to just retrofit workspace.

II.WHAT IS LINE FOLLOWER AGV?

- An automated guided vehicle is a programmable mobile vehicle. The mechanized guided vehicle is utilized as a part of modern application to move material around an assembling office. The AGV are capable of transportation task fully automated at low expanses.

- AGV have to make the system automatic by doing the decision on the path selection. This is done through different method frequency selected mode, path selected mode and vision based mode etc. The central processing system of AGV is issue the steering command and speed command. For the pre-defined manufacturing environment the line follower robot is good option for choice.



- A line supporter robot is a robot which takes after a pre-characterized way controlled by a feedback mechanism.The way can be unmistakably like a dark line on a white surface or (vice versa) it can be imperceptible like an attractive field.Detecting a line and managing the robot to remain on course, while continually rectifying. Pragmatic implementations of a line adherent are mechanical applications where these robots can be utilized as mechanized gear transporters in businesses supplanting conventional transport lines like conveyer belts in automobiles.

- Some current advancements in line supporter are found in applications such floor clearing, direction in broad daylight places, libraries etc. Most regularly utilized innovation in the accompanying robot are finished by utilizing microcontroller and without utilizing microcontroller.

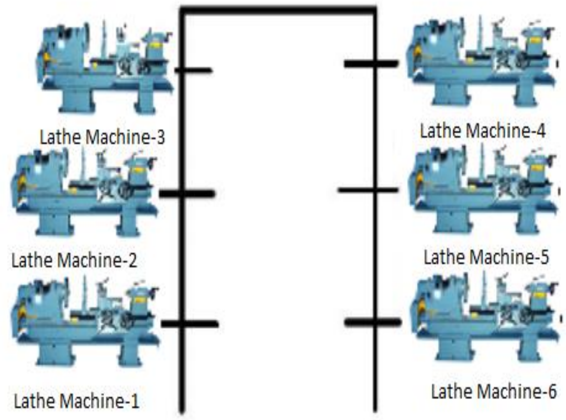


Fig: 2 (Lathe Machine with line drawing on the floor)

- A general AGV system essentially consists of vehicle peripheral on site component as well as stationary control system. The main components of line follower AGV system are

1) Sensor circuit
2) Processor
3) Driver
4) Actuators (Motors and wheels)
5) Vehicle

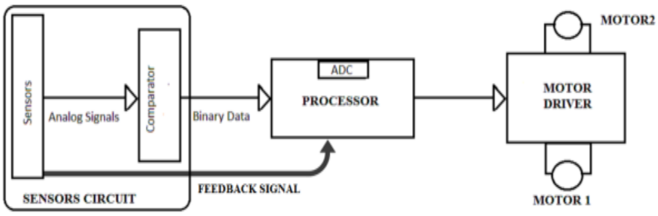


Fig: 3 (Block diagram of line follower AGV)

III.ROBOTIC LAWS

The law of robotics was well defined by the scientist Issac Asimov. The robotic laws are stated as follows

- A robot may not injure a human being or through inaction allow a human being to come to any harm.
- A robot must comply with the requests given to it by human being aside from where such requests would not strive the main law.
- A robot must secure its own reality as long in that capacity assurance does not struggle with the first or second law.

IV.DESIGN OF THE SYSTEM

A. Sensor Circuit:

A sensor is a device that detects the ratio between the output signal and measured property of input from the physical environment.In the line follower robot sensor circuit is responsible for detect the line segment or the path defined in the work floor. Robotics sensors are used in many implementations as object detection, path detection (line detection using color variation.), etc. also it can be easily integrated to microcontroller based controlling systems which are also widely used.

There are different types of sensor used in line follower AVG.

1) LDR sensor
2) Vision based sensor

3) Proximity sensor

B. Processer:

The processer is act as brain for line follower AGV. Usually the line adherent robot chips away at a shut circle input algorith where the criticism from the line sensor is utilized by the controller from amending the way of the robot. The sensors are normally LED/LDR, LED/Photodiode or LED/Phototransistor pairs and the controller is an electronic circuit which executes the coveted feedback calculation.In general, the line follower robot senses the colored path to navigate the vehicle. The input signal is coming from sensor array which send to the microcontroller to analyses the current position and give instruction to the driver according to pre-defined program. The assignment of the microcontroller here is to control the left and right engines as indicated by the input signals from the left and right comparators with the goal that the robot stays on the right way

The processer is also responsible handling the different task and communication with other control system. Deepak (2013) used 89c51 microcontroller to detect the path. Pakdamn(2009) used the Atmel's AVR microcontroller "At Mega 16" in the project. Since Atmel's AVR microcontrollers have a RISC center running single cycle guidelines and an all around characterized I/O structure that restrains the requirements for outside components. Internal oscillators, timers,SPI,UART, pull-up resistors, ADC, pulse width modulation, analog comparator and watch-dog timers are some of the features will find in AVR devices

C. Driver:

Motor driver act like the current amplifier. It is use for controlling the current in the motor. The motor drive provides high current as the dc motor need when it receives low current in the circuit. For drive the motors a high value of the current is needed. Deepak (2013) used L293D IC which can control the two dc motor simultaneously. It can rotate the motor in the forward and reverse direction. By using the motor driver, a line following robot can be move in clockwise and in anticlockwise directions. It completely controls the movement of the dc motor that's why it has been called as motor driver.

D. Actuator:

The movement system is an important part of a robot. And its objective is how to move robot from one point to another one. This system has some details shown us how we should use motors and wheels. We utilize motors to change over electrical vitality to the mechanical vitality.There are a lot of kinds of motors and we must choice the best one that we need. Our choice is depended on the robot function, power and precision. Undoubtedly, one of the agents of success of our robot is to choose good motors. For the proper movement of the system two dc motors has been used in the circuit and a castor wheel is attached in the front side of that Line Following Robot Based Health Care Management System. Caster wheel enable the movement of the robot is easy in every direction. Two dc motors at the end side of the robot is controlled by the motor driver.

V.CODING

```
#include <avr/io.h>
#include <avr/interrupt.h>
#include <util/delay.h>
#include <math.h>
#include "lcd.c"
void port_init();
void timer5_init();
void velocity(unsigned char, unsigned char);
void motors_delay();
unsigned char ADC_Conversion(unsigned char);
unsigned char ADC_Value;
unsigned char flag = 0;
unsigned char Left_white_line = 0;
unsigned char Center_white_line = 0;
unsigned char Right_white_line = 0;
void lcd_port_config (void)
{
DDRC = DDRC | 0xF7;
PORTC = PORTC & 0x80;
```

```
}
void adc_pin_config (void)
{
DDRF = 0x00;
PORTF = 0x00;
DDRK = 0x00;
PORTK = 0x00;
}
void motion_pin_config (void)
{
DDRA = DDRA | 0x0F;
PORTA = PORTA & 0xF0;
DDRL = DDRL | 0x18;
PORTL = PORTL | 0x18;
}
void port_init()
{
lcd_port_config();
adc_pin_config();
motion_pin_config();
}
void timer5_init()
{
TCCR5B = 0x00;
TCNT5H = 0xFF;
TCNT5L = 0x01;
OCR5AH = 0x00;
OCR5AL = 0xFF;
OCR5BH = 0x00;
OCR5BL = 0xFF;
OCR5CH = 0x00;
OCR5CL = 0xFF;
TCCR5A = 0xA9;
TCCR5B = 0x0B;
}
void adc_init()
{
ADCSRA = 0x00;
ADCSRB = 0x00;
ADMUX = 0x20;
ACSR = 0x80;
ADCSRA = 0x86;
}
unsigned char ADC_Conversion(unsigned char Ch)
{
unsigned char a;
if(Ch>7)
{
```

```
ADCSRB = 0x08;
}
Ch = Ch & 0x07;
ADMUX= 0x20| Ch;
ADCSRA = ADCSRA | 0x40;
while((ADCSRA&0x10)==0);
a=ADCH;
ADCSRA = ADCSRA|0x10;
ADCSRB = 0x00;
return a;
}
void print_sensor(char  row,  char  coloumn,unsigned char channel)
{
ADC_Value = ADC_Conversion(channel);
lcd_print(row, coloumn, ADC_Value, 3);
}
void  velocity  (unsigned  char  left_motor,  unsigned  char
right_motor)
{
OCR5AL = (unsigned char)left_motor;
OCR5BL = (unsigned char)right_motor;
}
void motion_set (unsigned char Direction)
{
unsigned char PortARestore = 0;
Direction &= 0x0F;
PortARestore = PORTA;
PortARestore &= 0xF0;
PortARestore |= Direction;
PORTA = PortARestore;
}
void forward (void)
{
motion_set (0x06);
}
void stop (void)
{
motion_set (0x00);
}
void init_devices (void)
{
cli();
port_init();
adc_init();
timer5_init();
sei(); }
int main()
{
```

```
init_devices();
lcd_set_4bit();
lcd_init();
while(1)
{
Left_white_line = ADC_Conversion(3);
Center_white_line = ADC_Conversion(2);
Right_white_line = ADC_Conversion(1);
flag=0;
print_sensor(1,1,3);
print_sensor(1,5,2);
print_sensor(1,9,1);
if(Center_white_line<0x28)
{
flag=1;
forward();
velocity(150,150);
}
if((Left_white_line>0x28) && (flag==0))
{
flag=1;
forward();
velocity(130,50);
}
if((Right_white_line>0x28) && (flag==0))
{
flag=1;
forward();
velocity(50,130);
}
if(Center_white_line>0x28&& Left_white_line>0x28&&
Right_white_line>0x28)
{
forward();
velocity(0,0);
}
}
}
```

VI.SOFTWARES USED FOR DUMPING THE PROGRAM

The coding of the black line program was compiled in the AVR studio 4 and it is checked for errors and warnings. When the program has built with no errors then the default header file is being created and then it is being burnt into the controller using AVR Boot loader. Then when the program is being run the following output. The output is obtained for a distance of few meters.

- AVR Studio

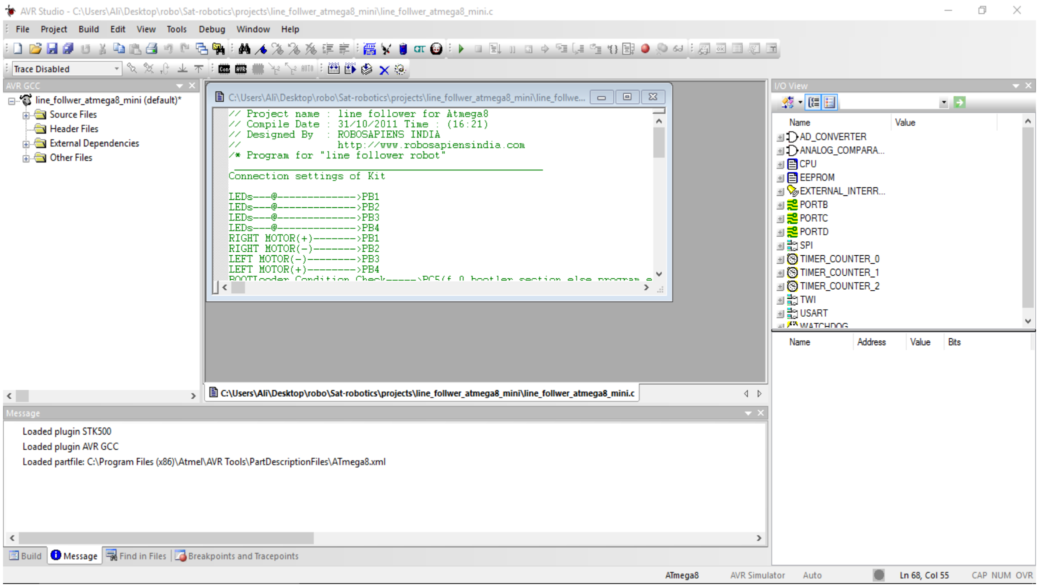


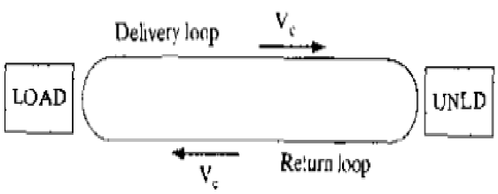
Fig: 4 (AVR Studio software)

- HID Boot Flash

Fig: 5 (HID Boot Flash software)

VII. ANALYSIS OF LINE FOLLOWER AGV

Mathematical model can able to describe the operation of AGV inside the manufacturing / warehouse unit. Efficiency of AGV can measure by efficient drive time of AGV from loading to unloading cycle. For this mathematical model we can assume that AGV moves in constant velocity throughout the environment and ignore the effect of acceleration deceleration and other speed difference. The time for a typical deliver cycle system (Fig.6) of AGV is



(Path analysis of line follower AGV)

$$T_c = T_l + L_d/v + T_u + L_e/v$$

Fig: 6 (Path analysis of line follower AGV)

1) Loading at the pickup station
2) Travel time to the drop-off station
3) Unloading at drop off station
4) Empty travel time

Te = delivery cycle time (min/delivery)
Tl = time to load (min)
Ld = distance travel load to unload station
v = carrier velocity
Tu = time to unloading station
Le = distance the vehicle travel until the start of the next delivery station
To find number of vehicle inside a environment

$$n = \frac{WL}{AT}$$

n = number of vehicle
WL = work load (min)
AT = available time (min)
To find total work load time or the total amount of work express in term of time so

WL = Rf Ta

Rf = total deliver constant per hour for the system
AT is defined by available time per hour per vehicle
AT = 60 A T E
Using the above equation, we can find how many AGV can fit in certain workspace. It calculates the time require for completing a task .so by considering this equation we can optimize the ideal time of AGV.

VIII. APPLICATIONS

Autonomy is the key factor for using AVG in different field. It will achieve high degree of accuracy and precision which will lead to minimize the error of the complete system and improved lead time.
1) Material handling: used in highly automotive and electronic factories, loading unloading station
2) Warehouse: used in e commerce warehouse for transporting the material
3) Commercial: baggage transport inside airport, supermarket, mall, floor treatment like wash, swap, scrub unpleasant job like washing warehouse
4) Energy and defence: transport the material human unreachable place, bomb and mine mapping, retrieval and disposal nuclear plant inspection, and steam generator, pipeline inspection
5) Medical service: deliver food water and medicine, administrative reports, handling hazardous material, disposal of biological waste
6) Personal care: Assistance for handicapped and early assistance with personal hygiene

IX. CONCLUSION

There are several possible directions for further research; we can improve the guided tape type AGV utilizing better navigation technique. It can be adopted any environment and cheap among autonomous robot. There is significant amount of difference between theoretical and practical work cycle value of time which can be optimized by adopting different methodology. In addition, one could think of the traffic control scheme so that multiple vehicles can operate in single floor efficiently. If they turn too sharply or drift and lose the track the AGV cannot recover. It can improvise by using feedback algorithm.

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