Autonomous Robot for Industrial Application using Labview

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ABSTRACT
This paper is based on autonomous robot which is used for transportation purpose, intelligent controlled system consisting of various modules interconnected through inflexible links in series by revolute joints. The development of intelligent vehicle on master-slave robot manipulators was rapidly followed by more complicated systems capable of independent, repetitive operations. This work presents design and development of an Automatic vehicle for industrial environment using LabVIEW and its real-time hardware implementation. The vehicle moves forward, backward, left and right through the signals supplied by the control station. The additional feature of this vehicle is capable to identifying the obstacle in its path when it moving.

Keywords
Robot, Sensor, Motor Drive, LabVIEW Programming.

1. INTRODUCTION
Robot is a fictional superhero appearing in the books and in labs, which is designed by Robotics engineering. A intelligent machine or autonomous vehicle is an artificial intelligent vehicle. In practical performance, it is usually an electro-mechanical system which, by its exterior or movements [10]. Robot is an assistant of intelligent machine. It is imaging by the German scientist to assist human being in various task.

Intelligent machine on earth: Typical industrial application robots do jobs that are complicated, unsafe or deadly [12]. They pick up robot items, coat, grip chemicals, and perform different kind of work. They achieve the similar job within a hour after house, day after day with accuracy. The autonomous robot does not get tired and they do not make error associated with weakness and so they are ideally suited to performing repetitive tasks. This dissertation is an attempt to design and develop automatic vehicle for industrial application in risky areas.

2. MOTIVATION
Human Intelligence, speed of thinking, capability of adjustment and the obstacle robot avoidance in real time situation and making decision in short time during runtime in environment inspired the researcher to develop an intelligentvehicle which is safe, intelligent and optimally find its best path in the static and dynamic, real-time environment.

3. HISTORY OF INTELLIGENT ROBOT
An exhaustive literature survey has been carried out before commencing the present work.

In the early 1965's robots where already able to walk, drive and live completely autonomous in cooperation with humans; at least in science fictions. Although fiction provides a good driving force to science, autonomous natural acting robots are still a giant leap away for humans to realize, though especially on the field of robotic motion planning great advances are made by scientists recently [3,4].

The study of basic robotic system design and development techniques has provided an adequate platform for the next generation of robots [1, 2]. Various works h robot been carried out on robotic systems including development of vision, robotic arm control, motion, obstacle sensing capability etc [5-8].

Wheeled mobile robots can increasingly become important in different fields in the near future. Robots could help humans in places less suitable for humans, like airport, hazardous waste sites, damaged nuclear reactors, deep space and in hospital. The response of micro-controller-based robot is very slow. They are not easy to design and control. The components used in these are very costly. For field programming gate array, micro-controller is highly dependent on temperature and they are complex in design. But nowadays, industries require a less temperature dependant robot as normal working environment temperatures are higher in industries as compared to the specifications of microcontroller-based robots.

The development of wheeled robot with controlled motion has been a point of interest for researchers in the near past due to its high degree of utility in various aspects of human life. The researches mainly include development of wheeled robots in linear and non-linear environments, automated highway systems, path planning strategies for a real-time obstacle track and robot navigation in unknown track etc.

Now a day's robotic is much broader area for engineers and researcher. The experimental performance which is done by scientist few years ago, dealing with research and development in a number of interdisciplinary research areas, including kinematics, dynamics, mathematical modelling, planning of vehicle, control and vehicle intelligence [14].

4. STEPS FOR DESIGN AND DEVELOPMENT OF ROBOT
Step I- First design a block diagram panel for giving the commands to our automatic vehicle. The commands will be forward, backward, left and right. The command will be transmitted through the DAQ, card to the receiver station.

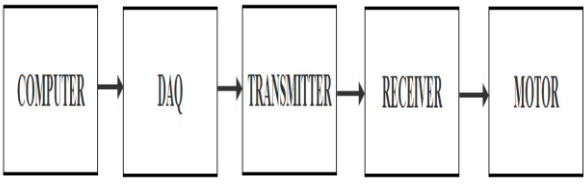


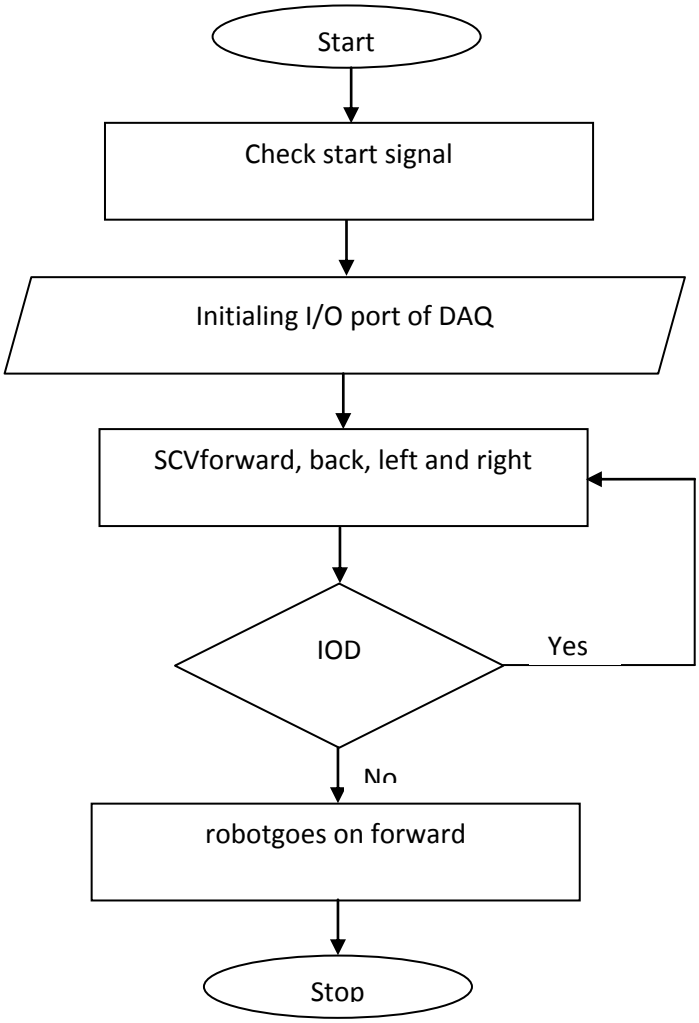
Figure 1: Block diagram of automatic robot

Step II- In this section our receiver antenna gets the information from the DAQ card and start doing task. The vehicle moves forward, backward, left and right. The IR sensor is used to detect the objects and gives commands to

control motor speed of front wheels to take turns of automatic vehicle. The speed of automatic vehicle is 10 km/hr. It takes turn very fast in motion.

Figure 2: Block diagram of automatic robot

Flow Chart of Robot Command System:



5. PROPOSED WORK

On the basis of historical evidences Microcontroller, embedded systems and appropriate Communication systems work to know engineering and understanding of obstacle detection and their robot avoidance. The state–of-art is both microcontroller and moving machine took advance steps in developing intelligent moving vehicle. This work focuses on the design and development of safe intelligent moving vehicle which has the capability to robot avoid obstacle in real-time. These obstacles may be known or unknown, static or dynamic.

6. PROBLEM STATEMENT

To design and develop of an efficient LabVIEW based moving automatic vehicle, which may move forward, backward, right and left, for application where human controlled vehicle is not suitable. It may also sense and avoid obstacles in its path. It also overcomes the drawbacks of human controlled vehicle.

7. SCOPE OF PAPER

A LabVIEW controlled autonomous robot has been design and developed. The vehicle can move forward, backward, left and right. This is a smooth-running automatic vehicle because we are using software based controlling technique instead of hardware such as microcontroller. This autonomous vehicle is highly useful for industrial purpose which can be used in transportation. The vehicle can work more efficiently in real time situation in industry. This vehicle is completely controlled through an intelligent control station (ICS).

8. OBJECTIVE OF PAPER

The main objective of the paper is design and develops a real-time obstacle avoidance vehicle to complete the task that requires distributed functionalities. In this context, the core research objectives are given below:

1. To design and develop the vehicle in lab.

2. To design and develop an obstacle avoidance algorithm for industrial vehicle.

3. The framework for vehicle and the obstacle avoidance program code in LabVIEW.

9. PROGRAMMING CODE OF LabVIEW

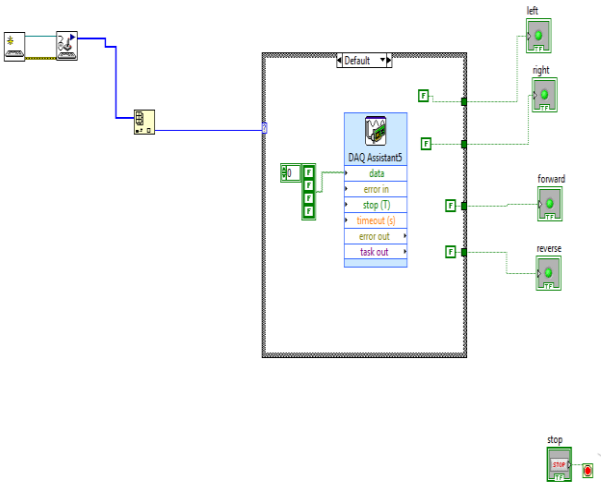


Figure 3: Block Diagram Panel

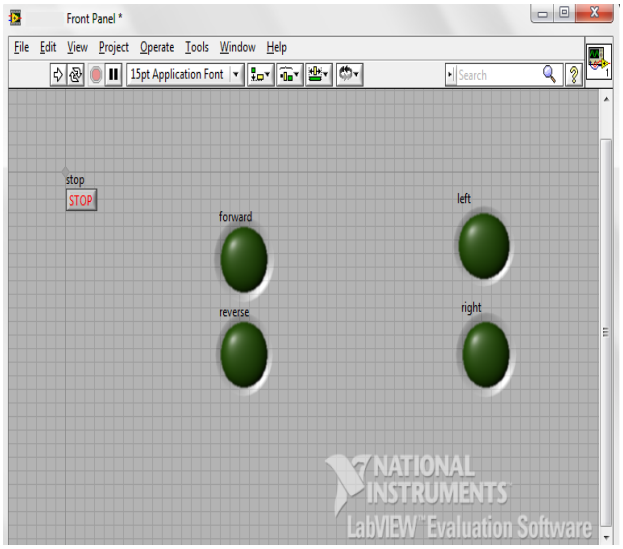
Development of Input Code for AR:

The LabVIEW is a graphical approach so we start from the block diagram panel. In this section we code a program for our vehicle which generates the signal in true/false conditions. If the condition is true then our vehicle will move forward and if the condition is false our vehicle will stop. In this panel the control output depends on five outcomes which are known as no action, forward, backward, left and right. These signals generate output which we can see at the front panel and from here we can send the signals to the DAQ card.

Four Arrow Keys:

→	←	↑	↓	**Control**
F	F	F	F	No action
F	F	F	T	Reverse
F	F	T	F	Forward
F	T	F	F	Left
T	F	F	F	Right

INPUT COMMAND FOR AR



10. GUIDANCE N ROBOTIGATION FOR AR

Presently, the 2-point n robotigation technique is implemented for the vehicle. The current position information in terms of Latitude and Longitude of the Destination Point (DP) is prefed to the vehicle and the information about the current position of the system is acquired through the onboard GPS. An imaginary Reference Trajectory (RT) is drawn at the start of the autonomous mode and the angle of this line (Reference Angle) with reference to the north is stored. This angle along with angle of current heading (obtained through GPS) is used to generate the Hdgerr.The perpendicular distance of thevehicle from the RT is termed as cross-track error (yerr). This cross-track error is also converted in to equivalent heading error and summed up to Hdgerr. The total heading error is restricted between –1800 and 1800 by passing through short angle computation. The scheme requires only GPS measurements. Depending on the sign of heading error, either left or right turn of steering is commanded, leading to left or right turns.

Code using of during obstacle robotoidance

#define OLED_RESETPIN 7

#define OLED_BAUDRATE 57600

#define OLED_INITDELAYMS 1000

#define OLED_DETECT_BAUDRATE 0x55

#define OLED_COMMAND_CONTROL 0x59

#define OLED_COMMAND_DISPLAY_OFF 0x00

#define OLED_COMMAND_DISPLAY_ON 0x01

#define OLED_COMMAND_SHUTDOWN 0x00

#define OLED_COMMAND_POWEROFF 0x01

#define OLED_COMMAND_SLEEP 0x5A

#define OLED_COMMAND_STOP_SD 0x80

#define OLED_ACK 0x06

#define OLED_NAK 0x15

// Graphics

#define OLED_PUTPIXEL 0x50

#define OLED_READPIXEL 0x52

#define OLED_LINE 0x4C

#define OLED_SETBACKGROUND 0x42

// Text

#define OLED_SETFONT 0x46

#define OLED_FONT5x7 0x00

#define OLED_FONT8x8 0x01

#define OLED_FONT8x12 0x02

#define OLED_SETFONTMODE 0x4F

#define OLED_FONT_TRANSPARENT 0x00

#define OLED_FONT_OPAQUE 0x01

//----------

#define OK 1

```
#define NOT_OK 0

#define ON 1

#define OFF 0

#define YES 1

#define NO 0

#define DEG2RAD 0.0174533 // 7 decimal resolution

#define RAD2DEG 57.2957795 // 7 decimal resolution

#define tar_Lat 27.16275 // %ddd.dddddd format

#define tar_Long 77.9999167 // %ddd.dddddd format

//#define tar_Lat 27.097138 // %ddd.dddddd format

//#define tar_Long 77.917055 // %ddd.dddddd format

#define Radius_Earth 6371008.7714 //WGS84 Standard Airthmatic Mean radius of earth in meter //6371000.0(Old)

#define y_error_2_hdg_gain_const 0.20

#define y_err_boundry_value_const 5.0

#define HDG_ERR_2_ACT_CONST 1

#define coefficient 0.05

#define autotrim_gain_const 0.08

#define Set_speed 4.0 // kmph

#define MAX_MOTOR 3000 //15% Duty Cycle

#define MIN_MOTOR 1000 //5% Duty Cycle

#define MAX_STEERING 3550 //STEERING Servo max position

#define MIN_STEERING 2550 //STEERING Servo min position

#define MOTOR 9 // Pin no. 9 for Motor PWM OCR1A

#define STEERING 10 // Pin no. 10 for Steering PWM OCR1B

#define TP_RANGE 10.0 //m

//-------------------------------------------------------------------------------

#define MIDDLE_STEERING 90 // central position of STEERING servo in degrees, adjust for trim corrections if necessary

#define KP_Speed 1.2 // proportional part of PID control

#define KI_Speed 0.06 // integrator part of PID control

#define KD_Speed 0.00001 // derivator part of PID control (not used)

//PID max and mins

#define Speed_MAX 5 // Servo max position in degrees

#define Speed_MIN -5 // Servo min position in degrees

#define INTEGRATOR_LIMIT 0.5 // about +- 15 degrees
```

The paper is based on design and development of robot which will be capable for real-time application as problem solving and planning aspects. Experimantation test perform play a vital role in the field of intelligent robot. For observation and analysis the behrobotiour of vehicle would be process rather than just a data collection and processing it with control algorithms and hardware items that combines and structures experimental results for a detailed analysis of static and dynamic behrobotiour of robot. The robot performance will be changes with the passage of time. The development of smart control system for robot, in which its behrobotiour as expected. On the basis of historical evidences microcontroller, embedded systems, VI communication and appropriate communication systems work to know engineering and understanding of obstacle detection and their robotoidance. The state –of - art is both microcontroller and moving vehicle took advance steps in development of robot [16].

The program is developed for guiding the robot is based on the GPS data and limited lab testing has been carried out. Next test is performed while the vehicle was allowed to run on ground. Latitude and longitude of point inside the FET agra is preferred to the arduino along with the program as Destination Point (DP). The max value of duty cycle of motor is made lower and release of steering command after 200 ms is made in program to robotoid these things and the tests were conducted again. The holding of turn command is also increased for 400 ms and the tests were carried out with modified hardware. However the system was found to be not working as per the expectation. The GPS of update frequency of 1 Hz as the only sensor for guiding the vehicle autonomously is found to be incapable up to this point of testing. It is felt strongly that either we should employ the GPS sensor with higher frequency of update rate or magnetic compass. It is also felt that if the vehicle has to move the long distance then finally its steering got stabilized. The figure 4 and 5 is indoor/outdoor performance test of ROBOT.

Fig.5 Experimentation at Outdoor Platform

11. CONCLUSION

The automatic vehicle is smooth running system due to the use of embedded based soft computing technique. This techniques based on software and Arduino system performance. The control command of microcontroller based on LabVIEW program. The developed automatic vehicle also senses and avoids the obstacles in its path. It changes its movement very fast. The signal given through the the control board it changes its directions in 0.3 second. The trajectory angle with obstacle is 45° when vehicle is moving forward and sudden change in its phase.

- As per the paper objective the design and development of the software which could be utilized for guiding and controlling the vehicle autonomously.
- In the present state the reference position (Lat, Lon) of origin is taken as current FET agra position. Since in this research 1 Hz GPS sensor is utilized, the stepped output in both (steering & speed) is observed. However, if the current heading information is obtained through magnetic compass, then the performance would be superior.
- The integration of command shaper will be first done in the software for smooth movement and the tests would be carried out.
- The prototype of robot is developed in the lab as per the objective, defined in lab and tested in real time indoor/outdoor environment.
- For making the full simulation environment, the control strategies would also be developed and testing would be carried out.
- For modelling part, it is possible to model an robot with a significant level of different methods. The real model of robot develops with embedded based technique that is helpful for system which is the proper integration of software and hardware to achieve suitable robot. The program code is also discussed in brief. Finally, the robot developed tested for different outdoor situations.
- Application of robot in military operation, industrial purpose, airport transportation and local transport purpose.

12. RESULTS

A LabVIEW controlled Autonomous robot has been design and developed which can move forward, backward, left and right. This vehicle is designed for fast response during operation time because we are using software based controlling technique instead of hardware such as microcontroller. This vehicle is completely controlled through an intelligent control station (ICS). This autonomous robot effectively avoids the obstacles coming in its path sensing them through sensors.

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