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Review Paper on Automatic Industrial Trolley

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ABSTRACT

Holomonic wheelchair is popular for its ability to move in constrained space because of their omni directional movement. in these paper we are introducing present design and development of a four wheel driven omni wheelchair for indoor purpose and reduced wheel slippage and friction. the design is evaluated with wheel load measurement from current consumption and vibration measurement with 3 axis accelerometer on the chassis. from result and analysis it is prove that our proposed design shows less slippage of wheel and vibration than previous design. This system can find its application as assistive add for geriatric population or as a smart indoor movement vehicle.

Keywords: Automatic trolley, Omni directional robot mobile robot.

I. INTRODUCTION

Omni wheels are similar to mecanum wheels with small discs around the circumference of wheel which is perpendicular to the direction of rolling. The effect is that wheel will roll with full force but will also side. Many robot uses this wheels to have ability to move in all direction.

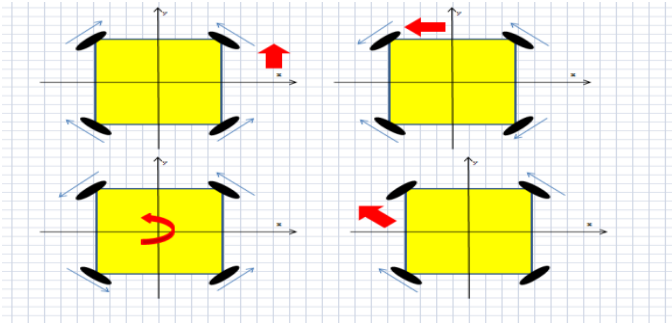

Fig 1- Omni Wheel motion

The figure shows Omni wheels mounted at an angle of 45degrees .here the direction achieved by this type of configuration is same as to what a triangular configuration achieve.

Omni wheels are design on the concept of normal wheel that has ability to roll or slip. The wheel is still able to move in that direction. The angle of smaller wheels relative to main wheel also give the wheels the name Swedish 90 degree wheel.

Fabrication is simple because it is easy to maintain wheel axis at 90 degrees to each other. Load carrying enhances because here the load is shared between 4 wheels. Calibration of motors is simpler.

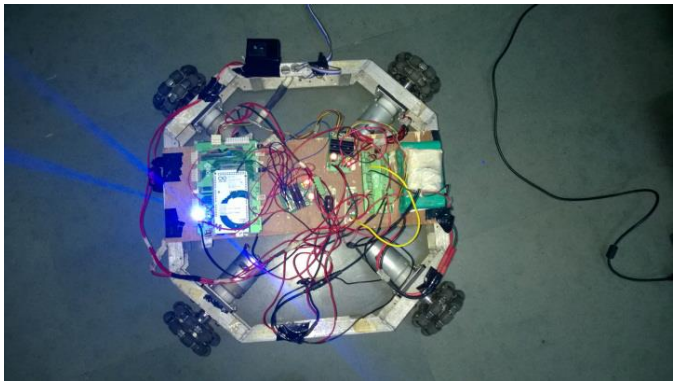

Fig.2 Omni wheel mounted at an angle of 45 degrees

HARDWARE DESIGN

According to requirement all the part of robot must be cheap and available at the market and to be easily replaced. We are using standard mechanics and controllers.

Mechanical part

We have selected centrosymmetric design with four circumferentially omni wheel.

Wheels are directly put to four electric motors contain build in speed reduction unit motors are mount at the bottom of silumin box. The box is providing for strength and flexibility for installing electronic component. Angle between motor 1 and motor N spindle Dn=90.

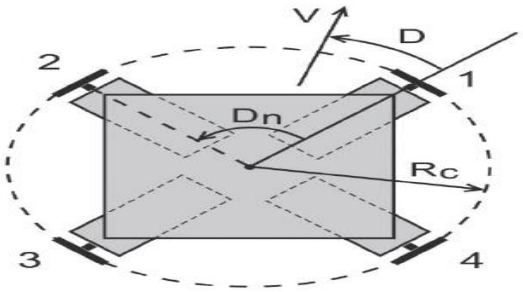

Fig. 3. Omni-wheel mobile robot structure

Electronics

Electronic part of the system is consists of double-channel L298 motor drivers, based controller, Raspberry Pi main onboard computer and Li 7.4 V battery as it shown in Fig. 4. The battery powers controller, motor drivers and motors directly. Raspberry Pi unit is powered by using 5 V regulator. The controller provides pulse-width modulation (PWM) signal for motor drivers calculates and executes basic motion algorithms and processes sensors input. The controller is also responsible for buffering motors and sensors related command from onboard computer, Communications Onboard computer and the controller are communicate each other by UART at 115200 baud rate using level shifter between units that utilize 3.3V and 5V levels respectively. High communication rate makes it possible to send more than 100 commands per second that allows changing motion parameters every centimetre of the robot route. These hardware limitations define maximum buffer length and ability to execute buffered commands on time. We found that Arduino controller takes up to 2 ms to process an individual command. Therefore UART communication rate is enough for selected design.

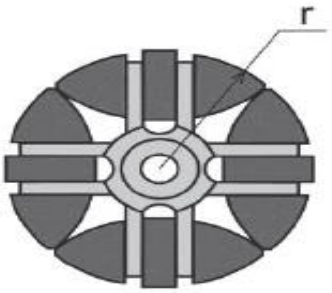

Fig. 3. Omni wheels used in the construction

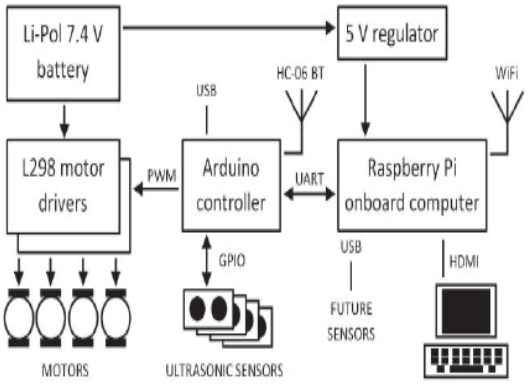

Fig. 4. Electronic components

Wi-Fi dongle is installed to one of two available USB ports

at Raspberry Pi. It provides connectivity between robot and

local network and Internet. Communication with robot could

be made. For debugging and uploading initial controller software we utilized external computer connected to the controller by using connector or HC-06 Bluetooth module connected to the controller UART instead of Raspberry Pi.

We also kept ability to connect remote USB keyboard and mouse and HDMI based display to Raspberry Pi.

Sensors Ultrasonic HC-SR04 distance sensor is installed at one of the robot box side and connected to Arduino GPIO pins. Based on our experiments the sensor can detect distance from 3 to 500 cm. We are

going to extend number of ultrasonic sensors in future. There are plans to mount other sensors like video camera and laser locator but exact sensors configuration depend on planned research and still under discussion.

II. METHODS AND MATERIAL

PVC and Nylon raw material used for Omni wheel drive and base of the robot were made by steel sheet which have dimension of 16 gauge. As this was a complete Mechatronic project incorporating mechanical, electronic and software development, the different areas were developed synergistically thus allowing interactions between the disciplines to be viewed and managed. It also meant that all core disciplines needed to be developed to a certain stage before any one area could be further worked on. Although it was physically possible to use other means to develop the core areas independently, a synergistic approach tends to be more efficient.

Developments and implementation

The development for this project can be divided into the major process, the mechanical design for Mecanum wheel and Omni wheel for mobile robot chassis, electronics design for 4 channel motor driver and interfacing with Basic Stamp controller board and software development for motion control.

Mechanical design

The mecanum wheel has been develop of eight roller with diameter of 110 mm. Each roller is of 20 mm at the centre and 16mm at end .All rollers are made from plastic. The roller is hold by holder which is made of MS and centre hub by nylon.

Methodology

Omni directional wheelchairs 14,15,16 posses maneuverability because of the Omni wheels which allows translational as well as lateral movement. Unlike differential or steering drive, allowing motion in both the body axis possible. Moreover, translational movement along any desired path can combined with rotation. N order to achieve these, the wheel is built using the smaller wheels attached along the circumference of wheel.

each wheel provides traction the direction normal to the motor axis and parallel to the floor.

Holomonic drive system is designed with mecanum wheels and Omni wheels. 4 wheels Omni driven wheelchair are not common, but designed is properly, 4 wheeled Omni drives provide better traction force compared to mecanum while turning.

III. LITERATURE REVIEW

Ananda Sankar Kundua is describe design and development of a 4 wheel driven Omni wheelchair with reduced wheel slippage and vibration. All the wheelchairs or indoor transporters with holonomic drive are developed with a three wheeled Omni platform. Mecunum wheels are inherently suitable for handling high load but its turn rate is slow compared to omni wheels. 4 wheel platform with Omni wheels are difficult to design, mainly because of its unequal ground reaction force. If designed properly, 4 wheeled omni platform provides better performance than platform developed with mecunum wheels. We propose a unique wheelchair design with Omni wheels and proper suspension mechanism to provide enhanced mobility in indoor environment. The design has been evaluated with wheel load measurement from current consumption and vibration measurement with a 3 axis accelerometer mounted on the chassis.

F. Ribeiro is describe the control software is very simple and efficient as described. According to the direction angle only three values are calculated by using a cosine value and a multiplication. The PWM to control the motors is generated by a PIC, leaving the computer processor free for other more complex tasks like the image processing and the game strategy. This configuration allows linear and angular speeds at the same time and this is of extreme importance for this team since each robot carries a fixed kicker. If the kicker is not in the robot

moving direction an angular speed needs to be used together with the linear speed while the robot moves towards the ball, in order to point the kicker to the right direction.

Sanket Son is describe an overview over the primary design stage of Omni-directional mobile robots using Omni wheel. The strength of theses wheels are the enhanced maneuverability of the mobile robot that needs extreme maneuverability in congested environment. This design and development of an Omni directional platform, using mechatronics system and Omni directional wheel to implement intelligent behavior and maneuvers, with the help of a microcontroller interfaced. The accuracy of direction and movement of the mobile robot depend much on slip rate of the wheel on floor' various conditions. As are result, the real position and orientation of the mobile robot deviate from the original planned course or path.

Kirill Krinkin is describe discussed problems and solutions discovered during small robust Omni-wheel robot implementation. The robot is designed for SLAM algorithms indoor research. Full stack from hardware implementation up to high level software was presented. Currently we have simple and robust platform for real indoor experiments and extensions. Mechanical design demonstrated strength. The robot was tested indoor and at some outdoor surfaces at up to maximum speed and acceleration without any damage. The robot is small enough to be used in rooms with limited space and still provides ability to mound additional sensors and electronic equipment.

Jigar J. Parmar is describe particular manual robot weighing 26 kilograms for the ROBOCON COMPETITION, we used four Omni wheels at an angle of 45 degrees to achieve desired direction of motion. With calculated combination of the wheel alignment and the direction of rotation of motor shaft, we had achieved 8 direction of motion. If the speed of individual motors can be monitored and changed, we can achieve curved path and also simultaneous rotational and linear motion. This is currently being used in robots and industrial equipment such as the forklift. They are under prototyping stage in future vehicles.

M.K.S.H.Maldeniya is describe design of an Omni directional robot made from using four mecanum wheels. An Omni directional robot is a robot that is capable of moving in any direction and is able to instantaneously change its direction at any given time. This can be advantages over a conventional mobile robot as it can avoid obstacles more easily and move through more complex paths that a conventional robot could not. This Omni directional robot is designed to have both autonomous capabilities as well as the ability to receive instructions from a remote control.

Genya Ishigam is describe a novel design of wheel for omnidirectional vehicle utilizing anisotropic friction properties has been described. The proposed wheel has a series of bendable nodes on its circumference, the surface of which is covered with materials having differing friction property. The proposed wheel can also grip to the ground with its high friction property, enabling the vehicle to generate much larger traction force than conventional wheels do. Thus, a significant improvement by the proposed wheel over the conventional omnidirectional wheels is the high traction performance while having equivalent omnidirectional mobility. In addition, the proposed wheel consists of single, moldable element and no mechanical components such as bearings and axles, which allows for a reduction in design complexity and potential for decreased production cost and increased robustness.

1. CONCLUSION

The control software is very simple and efficient as described. According to the direction angle only three values are calculated by using a cosine value and a multiplication. The PWM to control the motors is generated by a PIC, leaving the computer processor free for other more complex tasks like the image processing and the game strategy. The mobile robot

platform here described is relatively fast, reaching high both linear and angular speeds. Most time the motors do not drive at their maximum speed leaving a tolerance for when that is needed, for example, when linear and angular speeds are required at the same time. The platform wheel positioning is influenced by the motors size. In this case that was a problem because the motors were slightly large and the wheels had to be placed at the very edge of the platform.

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