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An Approach of Orientation Detection for balancing object on Robotic Vehicle for Non-Plane Surface

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Abstract: **-** In recent time development of multimodal robot or autonomous robots are designed for multiple requirements and multiple platforms. Many space research centers are working on robot which can control its position and also adjust their shape on demand.Falling robot is one of the biggest challenges in robot design for non-plane surface. Researchers' also developing different sensors for detecting object position in maximum possible coordinate with different degree of angle.Theproposed system is to make the robotic vehicle operated through computer system in different direction with inbuilt capability of self-balancing on non-plane surface.In this paper we demonstrate the tilt angle of the object. Basic technology used in proposed system is gyro-meter to identify tilt angle of object in order to give support from opposite side to neutralize the tilt angle and also neutralized effect of tilt by maintaining center of gravity.

Keywords: *- Autonomous robot, Center of gravity, Gyro-meter, tilt angleetc.*

I. INTRODUCTION

Robots can be autonomous or semiautonomous. Robotics is the branch of technology that deal with automated machines that can take the place of humans in dangerous environments or manufacturing processes, or resemble humans in appearance, behavior, and/or cognition. Many of today's robots are inspired by nature contributing to the field of bio-inspired robotics. Robots have replaced humans in the assistance of performing those repetitive and dangerous tasks which humans prefer not to do, or are unable to do due to size limitations, or even those such as in outer space or at the bottom of these where humans could not survive the extreme environments.

Recent years have witnessed a significant change in robotics research. The research emphasis appears to shift from the development of robots for structured industrial environments to the development of autonomous and cooperative mobile robots operating in unstructured and natural environments, such as homes or planet surfaces.The autonomous robot performing the number of challenging task such as cleaning of hazardous material, surveillance, rescue operation, battle field etc.In the industrieswidely used the wheeled mobile robot to carry some type of load. So that using wheeled mobile robot is the effective way to promote the factory automation [1]. An another way in the battle field or the rescue operation, if they know the position of the enemy used camera which is mounted on the robotic vehicles and that vehicles is moving on non-plane surface.

In robotic, falling robot is one of the biggest challenges in robot design for non-plane surface. In this paper, the object which is mounted on the robotic vehicle and that object does not fall on non-plane surface has the big issues.This paper introduce the algorithm which is helpful to balance that object which is mounted on the robotic vehicles and that vehicle must be move on the non-plane surface. In this paper, we take the example of glass of water which is mounted on the four wheeled robotic vehicle and that vehicle is moving on the non-plane surface. Non –plane surface like rocky surface, inclined surface, slop surface etc.This proposed system aimed to make a robot, powered by an electric motor, which could balance by it and move along a particular terrain.The primary aim is to make the vehicle capable enough to control the falling angle to keep itself stable on non-plane surface. For balancing any robot is to maintain the center of gravity. This is the major factor for balancing any object it may be robot or may be vehicle.An autonomous robot has its own capabilities of sensing its environment,navigating anddecision-making by its self. By using autonomous vehicles[2], humans can define the destination or path and the rest of the navigation will be taken care of by the system. An advanced control strategy will use the appropriate information to control the vehicle's navigation. The control system must be able to handle the road characteristics **-** i.e., straight, curvy, rough and varying terrain types.

II. LITERATURE REVIEW

In many paper number of algorithms are used for path detection, increase and decrease the speed of the robotic vehicles etc. Chun-Hsu Ko and team [3]proposed static path planning, acceleration/deceleration,slope guidance algorithm for a robot walking helper with both passive and active control modes for guidance. The team proposed the algorithm for walker helper robot which is used for the elder people who they are not able to walk on the hill and it improving the activities of daily living. Mohammad[4] provide the navigation to the mobile

robot using Fuzzy Logic developed for two wheeled vehicle robot in static environment. They developed the controller used the information about the target and low range sensory information to produce the commands that gives the direction to the mobile robot for reaching to the target within collision detection.
Michel Lauria and team[5] proposed a system AZIMUT for handling different types of terrains (indoors or outdoors) and situations such as moving slowly or rapidly, with or without the presence of moving objects (living or not), climbing over objects and potentially having to deal with hazardous conditions. Noel E. Du Toit and team [6] proposed a present's strategy for planning robot motions in dynamic, uncertain environments (DUEs). Successful and efficient robot operation in such environments requires reasoningabout the future evolution and uncertainties of the states of the moving agents and obstacles. A novel procedure to account for future information gathering in the planning process is presented.
The Mike Stilman and team [7] design and developed a Dynamically-Balancing Holonomic Robot that describe a controller that maintains dynamic balance during holonomic motion. The vehicle which is moving holonomically has number of drawbacks likea wide wheelbase,center of mass, and slow movement etc. so that the team constructed the wheel named Golem Wing to demonstrate that our wheel arrangement produces holonomic movement and that the vehicle can maintain its balance while moving in any direction so that Dynamic balancers keep the greatest forces pointed directly into the floor along the contact line, so adding to or raising the load does not introduce any additional danger of tipping when moving and vehicles can handle significantly larger loads relative to their mass[8], [9].This system balance the load but not for the different terrain. Ya-Chun Chang and team [10] the proposed system presents a trajectory planning for four wheel robot in an obstruct environment. Two 2-dimensional laser ranger finders are equipped on themobile robot in order to perform sensor-based planning withoutany a priori knowledge about its environment. Siba M. Sharef and team [11] developed the software simulation model for two wheeled mobile robot which can navigate the robot safely through an unknown environment. They perform four functions: motion control, obstacle avoidance, self-location and path planning for both local and global. The proposed controller is responsible for to create the trajectories between the start and goal points for the mobile robot navigation.

III. RESEARCH METHODOLOGY

Consider, proposed system mainly working on the principal of maintaining the center of gravity while running on non-plane surface in order to prevent the vehicle from falling in any direction. Fig. 1 describes the method for maintaining the center of gravity on slope. Balancing robotic vehicle maintains good traction by shifting its center of gravity above its wheel all the time for object placed on it.

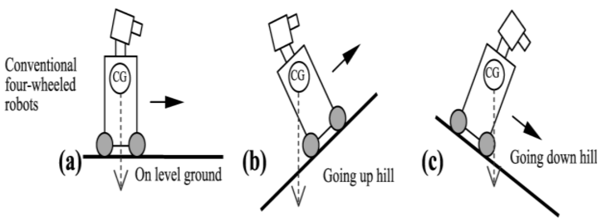


Figure 1: Robotic vehicle maintaining its CG on differentplane

From the figure 1, there are different ways to showrobotic vehicles on the different slope so that the vehicle should capable enough to control the falling angle to keep itself stable on the non-plane surface.
For balancing any robot, it is required to maintain the center of gravity. This is the major factor for balancing any object, if we maintain a proper center of gravity in that case object never fall down. In Fig 1-(a) shows that the robotic vehicle is moving on ground level so the center of gravity will manageproperly. Fig 1-(b) shows that the robotic vehicle is moving on the uphill; in that case it is required to maintain the center of gravity while moving.It prevents falling of the object which is mounted on the robotic vehicle otherwise the object may fall down.Fig 1-(c) shows that the robotic vehicle is moving towards the downhill and here we need to maintain the center of gravity during the motionof the robotic vehicle on the downhill, it prevents falling of the object which is mounted on the robotic vehicle.

Following algorithms are used for designing proposed system:
1.Acceleration and Deceleration Algorithm: Acceleration and Deceleration algorithm is used to control the vehicle moment and speed.Acceleration is when you speed up. Deceleration is when you slow down. The difference between the two is that they are the completely opposite.
2. Path State Detection Algorithm:Path detection is nothing but state detection for that we need to calculate the falling inclination angle.

***3. Control Algorithm*: ** Control algorithm to operate the servo motor in order to keep vehicle stable.
Servo Motors:Servo is also called an error sensing feedback control which is used to correct the performance of a system. Servo or RC Servo Motors are DC motors transitive with a servo mechanism for precise control of angular position. The RC servo motors usually have a rotation limit from 90° to 180°. But servos do not rotate continually. Their rotation is restricted in between the fixed angles. The Servos are used for precision positioning. They are used in robotic arms and legs, sensor scanners.

Center Of Gravity (CG):The object which is mounted on the robotic vehicle is in balance and the point at which all the surrounded weight is equal.

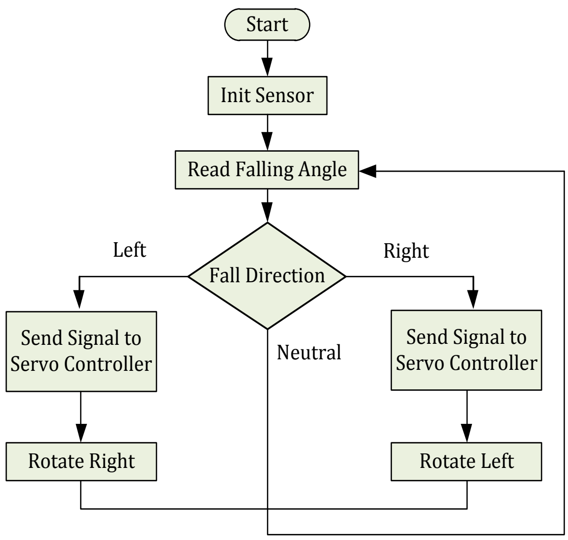
Gyro-meter:Gyro-meter is the electronics device which is used for measuring the orientation or tilt angle of the object which is mounted on the robotic vehicle. When the vehicle is moving from the non-plane surface terrain that time there is need for detecting the tilt angle of the object so that the object does not fall down during the motion of the robotic vehicles.

Accelerometer: Accelerometer is the electronic device which is used to determine the X co-ordinates and Y co-ordinates of the object which is mounted on the robotic vehicle. When the object is moving it continuously changes the values of X and Y axis and shows the result on to the LCD.

IV. PROPOSED PLAN OF WORK

Proposed system is mainly a wireless controlled four wheeled robotic vehicle with inbuilt capability to balance itself while driving at particular speed on non-plane surface. To achieve this with machine learning phase and embedded system we are proposing the system. This proposed system aimed to make a robotic vehicle but, powered by anbattery operated motor, which could balance by itself and move along a particular path. The primary aim is to make thevehicle balance on its own by controlling its center of gravity.

a. Building a circuit to detect the object state in co-ordinate system using gyro meter and accelerometer sensor.
b. Building self-running motors operated vehicle powered by batteries.
c. Develop hardware to control vehicle's main body in order to balance the vehicle.
d. Merging the input provided by sensors to PID controller in order to generate required degree of angle for vehicle operation controlling motor.



For determine the orientation detection we have to consider the no. of parameters. Height and width of the body affect the falling angle, ground clearance, wheel diameter.
For the proof of concept we developed a test bed setup to check the efficiency and feasibility of the proposed system. Here we develop a circuit to determine the X co-ordinate and Y co-ordinate. In order to balance the object on the robotic vehicle first we determine the falling direction and the falling angle of the object so that by applying force from the opposite side to the system, the system can stabilize the object and balance it by keeping it strait and neutralize the gravitational force.

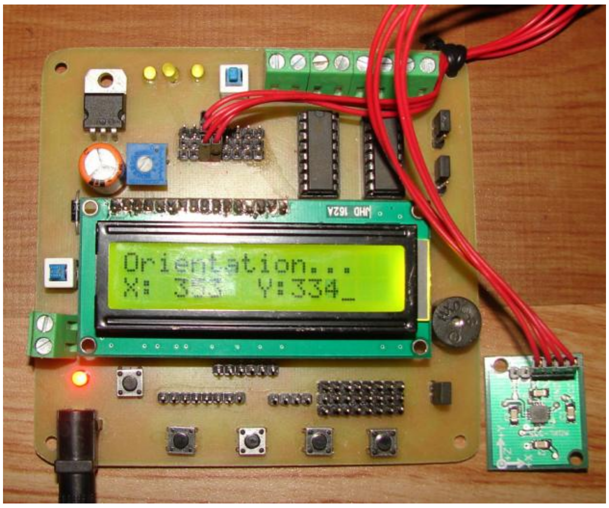


Figure 3: Orientation Detection

From Figure 3 to determine the falling angle, we used the accelerometer.So first accelerometer sensor will detect the falling angle of the object and provide this input to the PID controller. PID controller is used to calculate the falling angle. The microcontroller read the X and Y co-ordinates and send these values to the LCD 16*2(16 character 2 line) used to show the X co-ordinates and Y co-ordinates. According to the co-ordinates we will conclude the tilt angle.PID controller then calculates the angle for servo motor controller and supply PWM signals to servo controller. As servo controller controls the motor connected to vehicle and then motor will control the vehicle and keep the object strait.

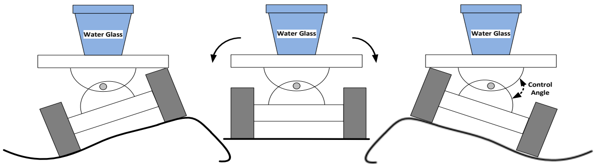


Figure 4: Example of balancing water glass on different planes

Figure 4 shows the example of the balancing the glass of water which is mounted on the robotic vehicle while moving on the non-plane surface terrain. The proposed system is going to design robotic vehicle with the ability to keep the object straight to the surface. In this keeping the object, robot body and surface should be parallel to each other.

V. CONCLUSION

Proposed system is to make the autonomous robot vehicle operated through computer system in different direction with inbuilt capability of balancing object on non-plane surface.It is expected from the proposed system that it should manage to balance water glass on its top even after running on different plane. Acceleration/Deceleration Algorithm,Path State Detection Algorithm,Control Algorithm allow an autonomous robot capable of self-balancing itself on different terrain.By designing and developing the proposed system we can give new way totransportation to provide better balancing at non-plane surface also. In this paper we have demonstrated the orientation detection phase. Using the output of this phase we can calculate the tilt angle or falling angle of robotic vehicle on non-plane surface.

REFERENCES

[1] S. Hoshino, H. Seki, Y. Naka and J. Ota,” Fault-tolerant multi-robot operational strategy for material transport systems considering maintenance activity”, Journal of Robotics and Mechatronics, vol.22, no.4, pp.485-495, 2010.

[2] Muhammad AizzatZakaria,HairiZamzuri, RosbiMamat and SaifulAmriMazlan”A Path Tracking Algorithm Using Future Prediction Control with Spike Detectionfor an Autonomous Vehicle Robot” International Journal of Advanced RoboticSystems int.j.adv.robot.syst,2013,vol.10,309:2013

[3] Chun-Hsu Ko,Kuu-YpungYoung,Yi_CheHuang,and Sunil Kumar Agrawal “ Active and Passive Control of Walk –Assist Robot for Outdoor Guidance” IEEE/ASME Transaction on Mechatronics ,VOL.18 N0.3, June 2013

[4] Mohammad HamiruceMarhaban"Mobile Robot Safe Navigation in Unknown Environment"2012 IEEE International Conference on Control System, Computing and Engineering, 23 - 25 Nov. 2012

[5] Michel Lauria,FrançoisMichaud,Marc-Antoine Legault, Dominic Létourneau, Philippe Rétornaz, Isabelle Nadeau, Pierre Lepage, Yan Morin, FrédéricGagnon, Patrick Giguère, JulienFrémy, Lionel Clavien"Elastic Locomotion of a Four Steered Mobile Robot"IEEE/RSJ International Conference on Intelligent Robots and Systems2008

[6] Noel E. Du Toit, , Joel W. Burdick "Robot Motion Planning in Dynamic Uncertain environments"IEEE Transactions On Robotics, Vol. 28, No. 1, February 2012

[7] Saul Reynolds-Haertle Mike Stilman"Design and Development of a Dynamically-Balancing Holonomic Robot" Georgia Institute of Technology, Technical Report, GT-GOLEM-2011-005, 2011
P. Kolhe, N. Dantam, and M. Stilman."Dynamic Pushing Strategies for Dynamically Stable Mobile Manipulators." In IEEE International Conference on Robotics and Automation, 2010. Proceedings . ICRA'10, 2006

[8] S. Kuindersma, E. Hannigan, D. Ruiken, and R. rupen."Dexterous Mobility with the uBot-5 Mobile Manipulator".In 14th InternationalConference on Advanced Robotics (ICAR'09), 2009.
Ya-Chun Chang, Yu YuLwin, Yoshio Yamamoto "Sensor-based Trajectory Planning Strategy for Non-holonomic Mobile Robot with Laser Range Sensors" IEEE International Symposium on Industrial Electronics (ISlE 2009)

[9] Siba M. Sharef, Waladin K. Sa'id, Farah S. Khoshaba "A Rule-Based System for Trajectory Planning of an indoor mobile robot"2010 7th International Multi-Conference on Systems, Signals and Device , ©201O IEEE