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IOT Controlled Two Wheel Self Supporting Robot Without External Sensor

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Abstract: An Two wheel self supporting robot is design using IOC(Internet-on-a-chip) controller. The DC motor is controlled by PWM technique. In the existing system the robot were designed using tilt sensor, IR sensor, Attitude sensor and moving robot in a straight line. We propose a new design in two wheel self support robot using the principle of curvature technique, were a force that makes the robot to follow a curved path. The direction is always perpendicular to the velocity of the robot, towards the fixed point of the instantaneous center of curvature of the path. Another advantages robot can be controlled world wide using IOC controller. It's now possibly the low cost platform available with combined high-end microcontroller and 802.11 functionality on-board.

Key words: Self Balancing Robot (SBR) · power supply · Internet-on-a-chip (IOC) · IOT (Internet-of-things)

INTRODUCTION

Two wheel balancing robot is designed to follow the line. The robot controller mother board is designed using IOC controller board. Four wheel self balancing robot for climbing the tree is designed using ATMEGA16. The climbing robot is controlled by RF. The climbing tree robot balances by adjusting the rotation speed of DC motor proportional to the tilt angle or the robot frame. In the robot for receiving the signal from the remote. The IOC controller is generating PWM signal for drive DC motor control. DC motor is controlled using on mobile phone through the internet. The drawback of the four wheel robotics that due to the irregularities in the tree trunk. This irregularities in tree trunk makes the robot to stuck. While passing the irregularity areas in the tree makes less tilt and makes the motor to reduce the speed. In one minute 4.6m the robot can climb the tree without maximum in the irregularies trunk regions.Inverted pendulum principle of two-wheeled self-balancing robot, this paper described the use of FPGA controller for attitude sensor data acquisition.

The design and implementation of a self-balancing two-wheeled robot is similar to the classical unstable, non-linear mechanical control problem of an inverted pendulum on a cart. The linearized system dynamics equations and approaches the control problem, of stabilizing the robot, using a Linear Quadratic Regulator for state feedback. For simulation result Kalman filter implementation is approached. After simulation, resulting implementation manages to stabilize the pendulum in an upright position and reject disturbances such as gentle pushes [1].

The design of an automatic self balancing control system for a tree climbing robot fabricate and test a self balancing control system for a four wheeled climbing robot. HM-RF transparent wireless data link module was used for transferring the data between the remote control and robot. The problems aroused by the tree climbing robots are due to the irregularities of the tree trunk surfaces. The PWM technique was used to control the speed of motors by providing intermediate amounts of electrical power between fully-on and fully-off situations. The tilt sensor that was used in this system was measured and the tilt angles. The remote send the data to the climbing robot and the microcontroller analyse them and make the appropriate decision. Corresponding to that, the robot could climb and pass the irregularities of the tree trunk successfully [2].

The dynamic dual wheel self-balancing robot was designed by differential equation method. The state space modelling procedure used for it. The PID controller is controlling the position by calculating the difference between actual set balance point and out come from overall system of self balancing robot. PROTEOUS, MATLAB and VM lab are used to simulate the result and observe the verified vital responses of different components [3].

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A two-wheeled self balancing robot was constructed with dual mode navigation having the capabilities to balance itself on the flat terrain or desired path. The distance sensors mounted for collecting information on tilt angle and speed sensors mounted for collecting information of the velocity of the body in relative to the ground. A microcontroller and direct current motor operatively coupled for processing information collected from the sensors to the microcontroller and for controlling the wheels vice-versa. The remote control is coupled with microcontroller to operate the robot in dual navigation modes [4].

The stabilization of a self-balancing robot bicycle designed by using off-the-shelf electronics. It is an unstable nonlinear system which is similar to an inverted pendulum. Experimental results were showing the robustness and efficiency of the proportional plus derivative controller balancing the bicycle. The self-balancing bicycle uses a control moment gyroscope as an actuator for balancing. The system relies on gyroscopic precession torque to stabilize the bicycle while it is upright [5].

A sixth order dynamic model was developed and conceived within the Cyber- Cars Project, the intended goal of this was to provide an on-demand, fully automatic taxi service in an urban environment. Here, the control objectives are different since intended uses of the two vehicles are unalike; the Seaway longitudinal acceleration and thus velocity are controlled by the torque disturbance of the driver. So, when a driver leans forward, the Seaway accelerates forward to prevent the passenger from falling. This is the typical response of an inverted pendulum principle. In contrast, the two wheeled balanced vehicle trajectory must be entirely controlled by the steering computer. Then, the passenger motion is a disturbance to be rejected. Furthermore, this model is meant as an alternative road vehicle, not intended for the sidewalk [6].

An accelerometer and a rate-gyroscope built into the micro-controller were implemented in order to achieve a vertical balance. In this model, fusion of both sensor data into a single usable value was achieved through a complementary filter. As result, the output of the supportive filter was designed to be primarily dependent on the gyroscope data, to which a fraction of the accelerometer data was added to compensate for the gyroscopic drift. The control loop and the PID controller acted as a closed loop feedback mechanism, in order to balance the robot [7].

The remote controlled self-balancing mobile robot specific parts are designed to the integration of electronic, mechanical and software sections. The LQR control has been implemented in the final version of the robot. Because of the need to use the knowledge in the fields of mechanics, electronics, programming and control, it had most representative mechatronic problems [8].

For inverted pendulum principle of two-wheeled self-balancing robot, this paper described the use of FPGA controller for attitude sensor data acquisition system design. It included powerful advantage of reconfigurable hardware that we select FPGA controller to substitute MCU, ARM and DSP controller, etc. two-wheel self-balancing robot in the application environment. The design realized data acquisition with inertial sensor in self-balancing robot system which is based on FPGA controller. The model used the idea of reuse area to solve the problem that several sensors collect data simultaneously and output parallelly, it achieved early data acquisition with inertial sensors in FPGA controlling system. At last data acquisition module are verified through the experiments and simulation and the design of self-balancing robot with FGPA controller achieved [9].

Based on the structure model of a two-wheeled self-balancing robot, a systematic mathematical model was devised according to dynamic mechanics theory. A kinetic equation was constructed using Newtonian dynamics and mechanics, which is based on system structure model. The number of simulation done and then a fuzzy PD controller is designed. The position and speed of robot are inputs and for this the angle and angle rate are controlled by PD controller [10].

A two-wheeled robotic machine (TWRM) has a challenging issue of balancing when the load carried by the machine is changing position along the vehicle intermediate body (IB). To overcome from this problem two types of control techniques are developed and implemented on the system, the traditional proportional-derivative (PD) control and fuzzy logic (FL) control. Simulations had been carried out for two variables namely; the level and duration of a disturbance force and the position and speed of the payload [11].

Two wheeled balancing robots are an area of research that may provide the unique stability control that is required to keep the robot upright differentiates it from traditional forms of robotics. The inverted pendulum principle is used to provide the mathematical modelling of the naturally unstable system. As problems and difficulties started in the programming, the expectations reduced to simply providing a robot that could maintain stability. The software and programming side was not well executing with the majority of the difficulties encountered in these areas [12].

The research on two-wheeled inverted pendulum (TWIP)mobile has gained momentum over the last decade in a number of robotic laboratories around the world. The paper deals with the hardware design of such a robot. A TWIP mobile robot as well as MATLAB interfacing configuration to be used as flexible platform comprises of embedded unstable linear plant intended for research and teaching purposes. The results showed that the proposed embedded design architecture based on Matlab is capable of delivering the desired outcome [13].

Two wheeled balancing robots are based on inverted pendulum principle which relies upon dynamic balancing systems for balancing and manoeuvring. The purpose of designing a self balancing two wheeled robot using Android phone which is a mechanical arrangement consisting of a long body supported by two wheels on one end. The aim is to build a self-balancing robot and replace all the conventional sensors such as accelerometer, gyroscope with a single android phone which along with having all the sensors provides an option for onboard signal processing [14].

From the above the literature review the two wheel robot is designed for the purpose of less track space and easy to steer. The two wheel balancing robot can be used for cut through the obstacles then four wheel robot with high steer ability and less weight the two wheel robot can move faster. These 2 wheel robot can be used in transportation areas where man cannot move and four wheel robots cannot move. So for the robot where design for surface of irregularis, balancing, line tracking etc. in this paper we designed a low power consuming robot with IOC controlled PID algorithm in the processor. The speed of the robot is increased by applying PWM of DC motor.

Methodology: The CC3200 contains a variety of features including an in-built network processor to handle popular protocols such as TCP and UDP,secure connectivity including TLS/SSL and a main ARM Cortex-M4 core for running application. In fact the CC3200 is a multi processor chip;the network processor subsystem inside contains another ARM core dedicated for the task. It's in-built lot of I/Os and also in-built DC-DC converters so that it can operate with a very battery range of 2.1V to 3.6V. It would be useful for IoT devices including nodes and gateways.

many microcontroller which contain built-in Flash memory for storing the code,the CC3200 has a large chunk of in-built static RAM(SRAM) that is loaded with the code from an external 8-pin serial Flash chip,it's has an entire file system a can be used to optionally store additional files. The CC3200 launchpad is feature-packed.

Fig. 1: Photo of the controller board.

Fig. 2: Photo of the Robot

It is about the size of a Raspberry Pi and contains two 20-pin headers that provide general purpose I/O,ADC channels,I2C,SPI,PWM and other functions. It contains a built-in USB-to-JTAG interface intened for debugging and flash memory programming and 802.11 antenna, some geral purpose switches and LED and a nice "sensor area" which contains an accelerometer and thermocoupile sensor which measure temperature remotely by pointing it at an object.The Figure 1 shows the photo of the controller board.

The Figure 2 shows the photo of the Self balanching Robot. DC motor converts electrical energy to mechanical work. It has 2 terminal devices first to apply voltage across terminals to provide a direct current to the motor and second to shaft speeds up to a terminal velocity. Often packaged with gearboxes and/or encoders. It act in accordance with Faraday's Law. It can operate directly from rechargeable batteries which provide the motive power for the first electric vehicles. DC motors are still found for applications of small toys, disk drives and in large sizes to operate steel rolling mills and paper machines.

The magnitude of the centripetal force on an object of mass m moving at tangential speed v along a path with radius of curvature r is:

$$F=ma_c=mv^2/r$$

Where a_c is the centripetal acceleration. Angular velocity *ω* of the object about the center of the circle:

$$F=mrw^2$$

Expressed using the period for one revolution of the circle, *T*, the equation becomes:

$$F=mr4v^2/T^2$$

derivations of formulas for velocity and acceleration of the Robot. In two dimensions the position vector r which has magnitude (length)r and directed at an angle □ above the x-axis can be expressed in Cartesian coordinates using the unit vectors $\bar{x}$ and ŷ:

$$r = r\cos(?)\ \bar{x} + r\sin(?)\ y$$

Assume uniform circular motion, the velocity v and acceleration can be found by a of the motion by making derivatives of position with respect to time.

$$r = r\cos(wt)\bar{x}+r\sin(wt)\ y$$

$$r = v =-rw\sin(wt)\bar{x}+rw\cos(wt)\ y$$

$$r = a=-rw^2\cos(wt)\bar{x}-rw^2\sin(wt)\ y$$

$$a = -w^2(r\cos(wt)\bar{x}+r\sin(wt)\ y)$$

r in Cartesian coordinates.

$$a=-w^2 r$$

The negative shows that the acceleration is pointed towards the center of the circle (opposite the radius), hence it is called "centripetal.

In Figure 3 Instantaneous center of curvature based robot wheeling. The self-balancing robot was designed and built by using the pic- microcontroller, dc motors, some basic electronic components to get the job done. Microcontroller is used to digitally control engine systems. It has capacity to regain functionality when its hold on for an event such as a button press or other obstruct. It contains a processor core, memory and programmable input/output peripherals. Similarly, when we want to rotate the motor backward direction front sensor should have lesser value compare to back sensor.

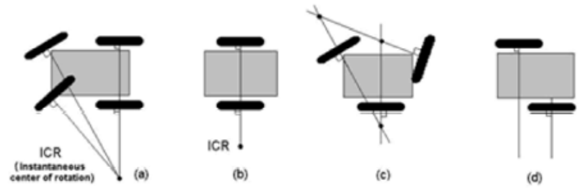

Fig. 3: Photo of the Instantaneous center of rotation(ICR)robot wheeling

When the motor rotates in forward direction the system will be moving at front. Likewise, when the motor rotates in backward direction the system will be moving at back side.wthere the wheel move forward or reverse it can controlled b apply pwm signal to DC motor from IOC controller.

CONCLUSION

From the experimental setup the robot was made to run continuously and the Instantaneous center of curvature was able to maintain by the robot. Still the performance of the robot has to be evaluated by running, in the different surfaces. The performance of the robot could be more efficient the principle of internet on chip controlled technique, were a force that makes the robot to follow a curved path is performed well. The direction is always perpendicular to the velocity of the robot is maintained, towards the fixed point of the instantaneous center of curvature of the path. Balanching is controlled by using mobile phone keys through internet.

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