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Automatic Bicycle For Physically Challenged (CYIKE)

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***Abstract* – An Automatic bicycle is a cycle used for general purpose along with the additional features for easy transportation. These additional features in this cycle includes self-balancing, GPS System, sensors, and a motor to drive the cycle with less human effort. It has been a major problem in cities which is heavy traffic with large pollution so to overcome this automatic bicycle can be used. But people hesitate to use bicycle because of its low speed and also due to more mechanical work is needed to move the cycle. This project aims to design a new smart bicycle which can move automatically with the help of sensors. People can reach their destinations with the help of GPS system and the display screen which will be in the front part of the cycle. The wheel of the cycle attached with the motor is connected to the rechargeable battery which makes the cycle to move. The sensors such as Lidar sensor,ultrasonic sensor and radar sensors are placed around the cycle and to monitor the position of cycle by 360* rotating camera and also to keep track of signals , other vehicles and external bodies. This e-cycle will create a great impact in the future as it is compact, economical, efficient and easiest way of transportation.**

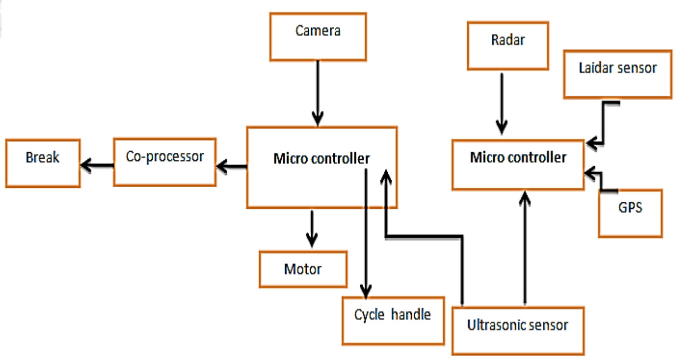
I. INTRODUCTION

The invention of integrated circuit and later microprocessor where major factors in the development of electronic control in automobiles. The importance of microprocessor cannot be overemphasized as it the brain that control many systems in cycle. For eg. A microcomputer then monitors the actual speed of the vehicle using the data from velocity sensors. The actual speed is compared to the desired speed and the controller adjusts the throttle as necessary.

A completely autonomous vehicle is one in which a computer performs all the tasks that the human driver normally would. Ultimately, this would mean getting on a cycle, entering the destination into a computer and enabling the system. From the, the cycle would take over and drive to the destination with no human input. The cycle would be able to sense its environment and make steering and speed changes as necessary. This vehicle would also detect to aid in passing slower vehicles or existing in highway; obstacle detection to locate other vehicles, pedestrians, animal, etc; adaptive control to maintain safe speed; collision avoidance t avoid hitting obstacles in the road way.

This cycle is fully equipped autonomous vehicle which is equipped with radar and Laidar and must more. Process is much quicker and reliable. It also has a combined information for Google street view with artificial intelligence software that combines input from video cameras, Laidar sensor, radar attachedin front of the cycle and position sensors attached to the rear wheel that helps to locate the position on the map. This automated driving system could help to reduce the number of traffic related issues and is more efficient.

GENERAL BLOCK DIAGRAM:



There are two coprocessors for handling the steering and the brake. Accelerator is directly controlled by the general purpose processor. The sensory inputs from the laidar, radar, position estimator and street view images. Laidar creates a 3-D images platform for mounting the obstacles and map. The camera visuals are used for detecting the colour of traffic signal based on which the vehicles move on the road. The general purpose processor is constantly communicating with the motor control unit.

The combination of these technologies and other systems such as video based lane analysis, steering and break actuation systems, and the programs necessary to control all of the components will become a fully autonomous system. The problem is winning the trust of the people to allow a computer to drive a vehicle for them, because of this , there must be research and testing done over and over again to ensure a near full proof
final product. This product will not be accepted instantly but over time the system becomes more widely used people will realize the benefit of it.

CONTROL UNIT

Hardware Sensors:

1. Radar :

Radar is an object detection system which uses electromagnetic wave specifically radio wave to determine the range, altitude, direction or speed of both moving and fixed objects such as ships, space crafts, vehicles, terrains.

The radar transmits the pulse of radio wave or microwave which bounces off any object in their path. The object returns tiny part of the wave energy to antenna which is located in the same site as the transmitter. The modern uses of radar are highly diverse, including air traffic control, radar astronomy, air-defence systems, antimissile systems; nautical radars to locate landmarks and other ships; aircraft anti-collision systems; ocean-surveillance systems, outer-space surveillance and rendezvous systems; meteorological precipitation monitoring; altimetry and light-control systems; guided-missile target-locating systems; and ground-penetrating radar for geological observations.

2.Laidar :

LIDAR (Light Detection And Ranging also LADAR) is an optical remote sensing technology that can measure the distance to, or other properties of a target by illuminating the target with light, often using pulses from a laser. LIDAR technology has application in geometrics, archaeology, geography, geology, geomorphology, seismology, forestry, remote sensing and atmospheric physics, as well as in airborne laser swath mapping (ALSM), laser altimetry and LIDAR Contour Mapping. The acronym LADAR (Laser Detection and Ranging) is often used in military contexts. The term "laser radar" is sometimes used even though LIDAR does not employ microwaves or radio waves and is not therefore in reality related to radar. LIDAR uses ultraviolet, visible, or near infrared light to image objects and
can be used with a wide range of targets, including non-metallic objects, rocks, rain, chemical compounds, aerosols, clouds and even single molecules. A narrow laser beam can be used to map physical features with very high resolution. LIDAR has been used extensively for atmospheric research and meteorology. Advanced Research Lidar. In addition LIDAR has been identified by NASA as a key technology for enabling autonomous precision safe landing of future robotic and crewed lunar landing vehicles. Wavelengths in a range from about 10 micrometres to the UV (ca.250 nm) are used to suit the target. Typically light is received via back scattering. There are several major components to a LIDAR system:

• Laser 6001000 nm lasers are most common for non-scientific applications.
• Scanner and optics
• Photo detector and receiver
• Position and navigation systems

3. Global Positioning System:

The Global Positioning System (GPS) is a space-based global navigation satellite System (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth.

Each satellite continually transmits messages that include
• The time the message was transmitted
• Precise orbital information (the ephemeris)
• The general system health and rough orbits of all GPS satellites.

The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite. These distances along with the satellites' locations are used with the possible aid of trilateration, depending on which algorithm is used, to compute the position of the receiver. This position is then displayed, perhaps with a moving map display or latitude and longitude;
elevation information may be included. Many GPS units show derived information such as direction and speed, calculated from position changes. Three satellites might seem enough to solve for position since space has three dimensions and a position near the Earth's surface can be assumed. However, even a very small clock error multiplied by the very large speed of light the speed at which satellite signals propagate results in a large positional error. Therefore receivers use four or more

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satellites to solve for the receiver's location and time. The very accurately computed time is effectively hidden by most GPS applications, which use only the location. A few specialized GPS applications do however use the time; these include time transfer, traffic signal timing, and synchronization of cell phone base stations.

4. Position Sensor:
A position sensor is any device that permits position measurement. Here we use a rotator encoder also called a shaft encoder, is an electro-mechanical device that converts the angular position or motion of a shaft or axle to an analog or digital code. The output of incremental encoders provides information about the motion of the shaft which is typically further processed elsewhere into information such as speed, distance, RPM and position.
The output of absolute encoders indicates the current position of the shaft, making them angle transducers. Rotary encoders are used in many applications that require precise shaft unlimited rotation including industrial controls, robotics, special purpose photographic lenses, computer input devices (such as up to mechanical mice and trackballs), and rotating radar platforms.

5. Camera :
There are two cameras one in the front and one in the back of the cycle. The image from the camera is taken as input and sent to the microprocessor. This input is takes as the base for the movement of the cycle. The system is a rosette (R) of 15 small, outward-looking cameras using 5 megapixel CMOS image sensors and custom, low-are, controlled-distortion lenses. The shadows caused by the 1st, 2nd and 4th generation cameras are occasionally viewable in images taken in mornings and evenings.
Google Street View is a technology featured in Google Maps and Google Earththat provides panoramic views from various positions along many streets in theworld. Google Street View displays images taken from fleet of specially adapted cycle.

DESCRIPTION FOR BALANCING

In order to meet the design requirements, potential designs for controlling the balance of the bicycle were developed and will be explained in this section. The three designs are described below with particular attention given to how well they meet the selection criteria: physical complexity, power requirements, programming code complexity, ease of turning/steering, math complexity, deviation from a straight line, cost, and closeness to resembling a bicycle.

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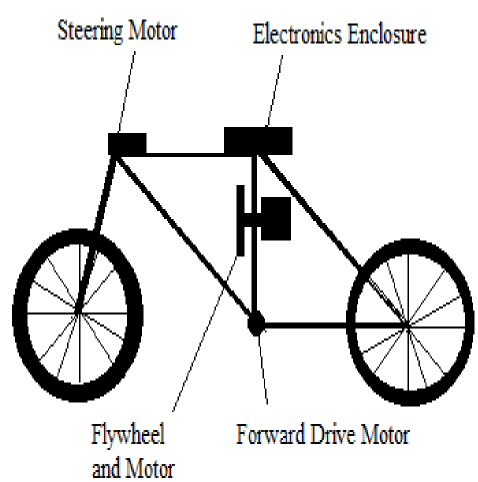

The flywheel design employs a flywheel which rotates about an axis parallel to the bicycle's frame. This design models the bicycle as a pendulum with a fixed pivot where the bicycle wheels meet the floor. As the bicycle begins to fall to one side, a motor mount to the bicycle exerts a torque on the flywheel, causing a reactionary torque on the bicycle, which restores the bicycle's balance.
The flywheel design has several advantages. This design is very stable: the bicycle can balance even in a stationary position. The mathematical model of this system is the least complex of the considered designs. Due to the simplicity of the design, the model would most likely be the closest to reality of the three designs. As a result of the relative math simplicity and the ease of starting and stopping, the controller would be relatively straight forward to implement. This design would also allow the bicycle to travel in a relatively straight line with only small deviations.
One of the main disadvantages of this design is that it does not likely permit easy steering, especially for higher speeds, considering that the PID gains will be optimized for straightline travel. Also, the frame would have to be

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altered, causing the design to look less similar to a bicycle than others.
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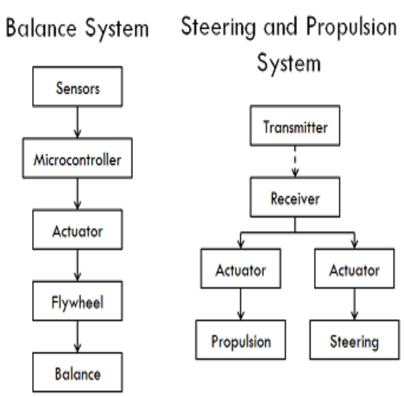
CONTROL OVERVIEW

The control of the bicycle is divided into two parts: balancing controlled by a microcontroller and steering and propulsion remotely controlled by an operator. The two control systems are described in further detail below, and the entire system is illustrated



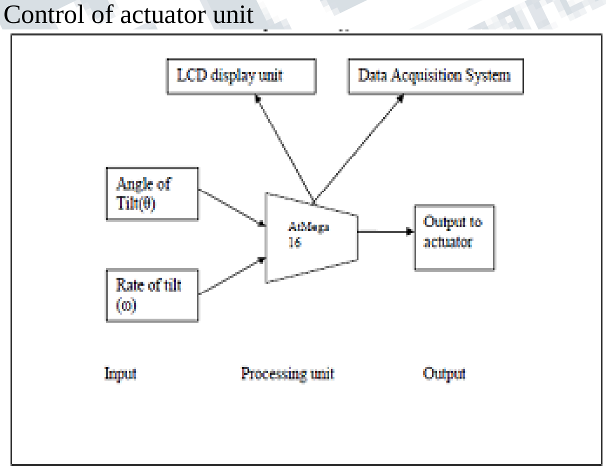
The AT mega 16 (the selected microcontroller) reads the output of the accelerometer and the gyroscope via the 12-bit analog-to-digital converter, and interprets the resulting values as a measurement of the bicycle's tilt angle. The measured angle is implemented into a PID algorithm, and outputs a corresponding voltage to the motor controller. The motor controller then outputs a voltage to the DC motor, which is geared down, and ultimately actuates the flywheel. A torque is exerted on the flywheel, and a reaction torque is exerted on the bicycle. This means in all aircraft with exception of agricultural and small general aviation airplanes, where the installation of a movable landing gear would increase the costs beyond the requirements of the aircraft category. Landing gear extraction is a primary operation and always its actuation has high redundancy.

MICROCONTROLLER UNIT

The microcontroller selected to control the balance ofthe bicycle is the AT mega 16.

The processing unit used is Atmel ATMega16 microcontroller unit which is a versatile EEPROM. It has four I/O (Input / Output) ports, onboard ADC (Analog to Digital Converter) and PWM (PulseWidth Modulation) outputs for motor control. It can be programmed easily with minimum hardware requirements which make it extremely popular in robotics applications. Here it performs the following functions:

ADC conversion of outputs of Rate Gyro and Accelerometer.
Processing the input signals
Periodic recalibration of gyro
Display of angle & other data.
Control of actuator unit



ANGLE SENSOR

Tilt sensing is the crux of this project and the most difficult part as well.
Triple Axis Accelerometer ADXL335
Dual Axis Gyroscope IDG500

To measure the bicycle's tilt angle, it was decided to use an accelerometer and a gyroscope, and to combine them using a complimentary filter. Integrating these two sensors proves useful when calculating the bicycle's tilt angle. Accelerometers may be used to measure the angle

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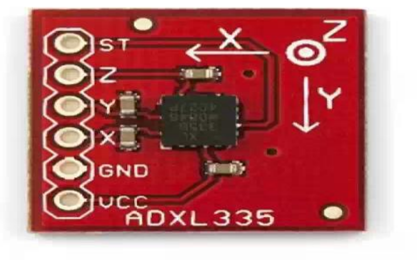
with respect to gravity directly, but they are highly susceptible to noise.



Gyros are less susceptible to noise, but they measure angular velocity. As a result, the gyro output must be integrated in order to obtain a measurement of angular position. This integration yields an error known as drift, a drawback of the gyro. Integrating both sensors allows one to easily combine the output of each sensor in order to obtain a more accurate angle reading. This is accomplished through the implementation of a filter, which combines the advantages of each sensor and eliminates the drawbacks of each sensor.

As the bicycle tilts, we need to apply a restoring force to return the robot to vertical position. A reaction wheel pendulum model is followed for the balancing purpose. The components used are:
• High torque 24V DC motor
• A metallic reaction wheel
• Motor driver L293D

To supply sufficient power to the flywheel, a fairly powerful motor and a gear reducer are required. In order to choose the motor, the designed frame and layout of components, as well as the calculations to model a simple inverted pendulum, were input into a MATLAB simulation using Simulink. This simulation allowed the team to determine the power, torque and velocity that the motor needed to supply. To meet these requirements, we use High torque 24V DC motor. The capacitor connected across the motor charges and discharges during the on and off time respectively, thus behaving like an integrator. The torque generated by the motor is a function of the average value of current supplied to it. It seems to be obvious that once we have angle we can rotate the flywheel with acceleration proportional to it, but that won't do the job. If that is done what actually will happen is that when there is a tilt the bike will cross the mean position and reach the other side till the same tilt angle. To fix this we need some kind of algorithm that can damp this periodic motion and make it stable at the mean position after some time. This is where PID (Proportional Integraland Derivative) Controller comes to use.

CONCLUSION:

This paper is highly concentrated on the bicycle using reaction wheel pendulum. Tilted information to roll axiscouldis attained through the sensor integration of complementary filter between gyroscope and accelerometer. The simplest structured PID controller has been applied to roll direction joint.As future works, robust controller for the roll axis to minimize external disturbances effects, and „S curved trajectory are under research.Sustainable and practical personal mobility solutions for campus environments have traditionally revolved around the use of bicycles, or provision of pedestrian facilities. However many campus environments also experience traffic congestion, parking difficulties and pollution from fossil-fuelled vehicles. It appears that pedal power alone has not been sufficient to supplant the use of petrol and diesel vehicles to date, and therefore it is opportune to investigate both the reasons behind the continual use of environmentally unfriendly transport, and consider potential solutions. This paper presents the results from a year-long study into electric bicycle effectiveness for a large tropical campus, identifying barriers to bicycle use that can be overcome through the availability of public use electric bicycle.

Applications:
• Intelligent transporting.
• Transportation in hazardous places.
• Shipping.
• Easy to use for physically challenged people.

Merits:
1) Safety.
2) Impacts on Traffic.
3) Fuel economy .

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