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Auto Adjusting Monopod

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Abstract - *In the world of cinematography, camera accessories plays very important role. There are different types of camera accessories among which tripods and monopods are one of the important accessories which have been used most. Now a days there are many different designs of tripods and monopods are available in the market. This project describes our work on building a special type of tripod, which balances the platform on which camera is mounted when the tripod is introduced to any movement. The platform stabilizes itself with the help of accelerometer. An accelerometer is used to estimate the posture through Kalman filter algorithm, then a multi-segment PID controller changes the motor alignment according to the platform motion and posture. The following chapters will cover the details about the components used, construction of the project and its working.*

Key Words: MPU 6050-Acc & Gyro, AT-MEGA 328

1. INTRODUCTION

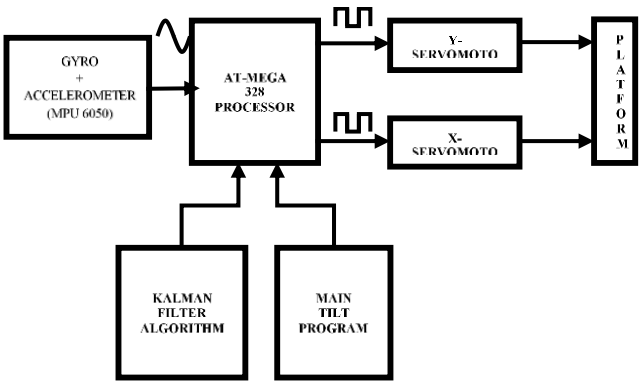
In the field of photography and cinematography camera accessories like tripod, monopods plays very important role. The main function of these accessories is to provide stabilization to the cameras while shooting. Tripod is one of the common accessory which are used by many photographers and cinematographers for their camera stabilization. Tripod is a 3- legged stand with a camera attachment over it. But tripod has its own disadvantages and it's not so versatile with the movement, if the camera man has to move from one place to another then moving his setup will cause him some trouble and it also disturbs the frame while recording.

To overcome such problems regarding tripods a new accessory was developed that is monopod. Monopod is a just one legged stand with a camera attachment over it. Monopods are used by the camera man who needs to make more movement while taking shots, it is more versatile to move than the tripods. Now, to make upgrades one level up we are trying to implement the self-balancing technology over the top the monopod which provides more stability to the camera platform while recording the shots.

Basically self-balancing platform consists of platform which is balanced by movement of two motors in opposite direction to the movement of the platform. In self-balancing platform the main components are position sensors, microcontroller and servo motors. Depending upon change in platform movement, controlling action is performed. Considering change in platform position due to some movements this change is sensed by position sensor (accelerometer) and signal is send to microcontroller. Depending upon the amount of change in position of Platform and direction, microcontroller energies respective servo motor to bring the platform back to is originally/ stable position. Two servo motors are attached to platform one from top end and other from bottom with help of clamps, such that it is parallel with respect to ground level.

2. METHODOLOGY

The platform on the top of the monopod stabilizes itself with the help of the two servo motors tilting on the opposite direction of the actual tilt made to the monopod. The main function of analyzing the tilt and giving signal to the servos is done by the AT-Mega microcontroller which analyses the tilt information provided to it by MPU-6050(Accelerometer+ Gyroscope) module.



2.1 MPU6050 (Accelerometer + Gyroscope)

The MPU-6050 sensor contains a MEMS accelerometer and MEMS gyroscope in a single chip. It is very accurate, as it contains 16 bits analog to digital conversion hardware for each channel. Therefore it captures the x, y and z channel at the same time. The sensor uses the I2C-bus to interface with the arduino.

It combines both an accelerometer and a gyroscope. The output of the MPU-6050 sensor is the combination of both accelerometer and gyroscope readings. Reading the raw values for the accelerometer and gyro is easy. The sleep mode has to be disabled, and then the registers for the accelerometer and gyro can be read, but the sensor also contains a 1024 bytes FIFO buffer. The sensor values can be programmed to be placed in the FIFO buffer and the buffer can be read by the Atmel Mega 328 processor

2.2 Atmel Mega 328 Processor

The AT-mega 328 processor is a low power CMOS 8 bit microcontroller based on the AVR enhances RISC architecture. By executing powerful instructions in a single clock cycle, the AT-mega 328 processor achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

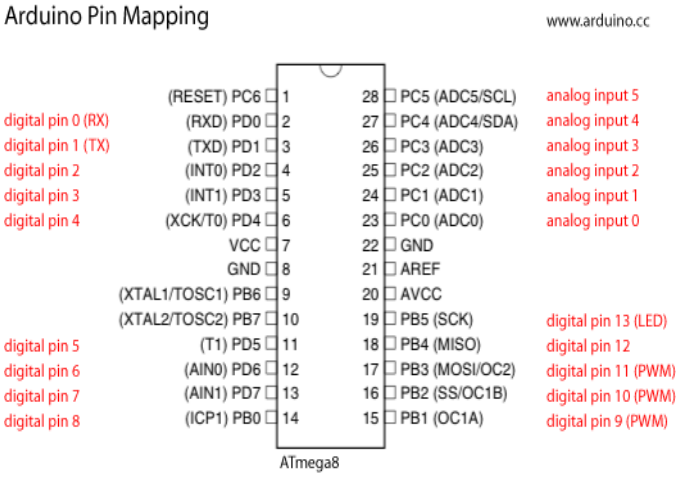


Fig -2: Pin Representation of At-mega 328

2.3 Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.

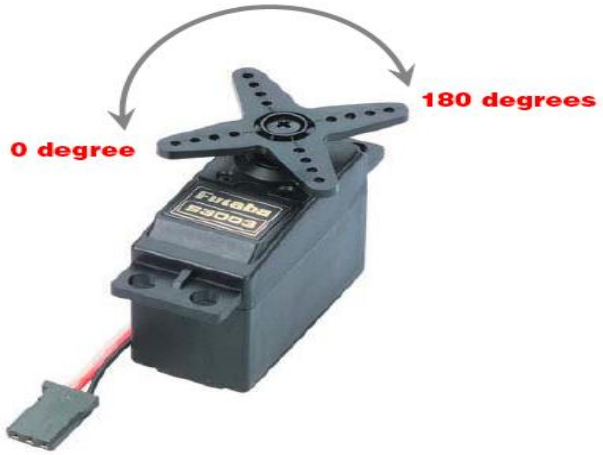


Fig -1: Servo motor

 # Servo Specifications

Control System: +Pulse Width Control 1520usec
Neutral Current Drain (4.8V): 7.2mA/idle
Required Pulse: 3-5 Volt Peak to Peak Square
Wave Current Drain (6.0V): 8mA/idle
Operating Voltage: 4.8-6.0 Volts Direction: Counter Clockwise/Pulse Traveling 1520- 1900usec
Temperature Range: -20 to +60 Degree C
Motor Type: 3 Pole Ferrite
Operating Speed (4.8V): 0.23sec/60 degrees at no load
Potentiometer Drive: Indirect Drive
Operating Speed (6.0V): 0.19sec/60 degrees at no load
Bearing Type: Plastic Bearing
Stall Torque (4.8V): 44 oz/in. (3.2kg.cm)
Gear Type: All Nylon Gears
Stall Torque (6.0V): 56.8 oz/in. (4.1kg.cm) Connector Wire Length: 12"
Operating Angle: 45 Deg. one side pulse traveling 400usec Dimensions: 1.6" x 0.8"x 1.4" (41 x 20 x 36mm)
360 Modifiable: Yes
Weight: 1.3oz. (37.2g)

3. CONCLUSIONS

In this paper, we exploit the working of auto adjusting monopod. The Kalman filter and PID algorithms are applied to coding in microprocessor. The auto adjusting monopod achieves its goal successfully. The platform can maintain its vertical balance position or based on the desired angle by users. The platform runs reliably and it has high robustness. Accelerometer and gyroscope provides the tilt angle and angular velocity information. The Kalman filter fuses both of

the sensors to provide reliable estimated angle information. The available control algorithms based on the different errors provide the appropriate PWM and drive platform to vertical equilibrium or move.

Most of the research and development involves control algorithms and system dynamics. Advanced controllers provides robust and optimal control for self-balancing platforms. What we are going to face is that how to uses advance control algorithms to make the monopod run more reliable.

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