

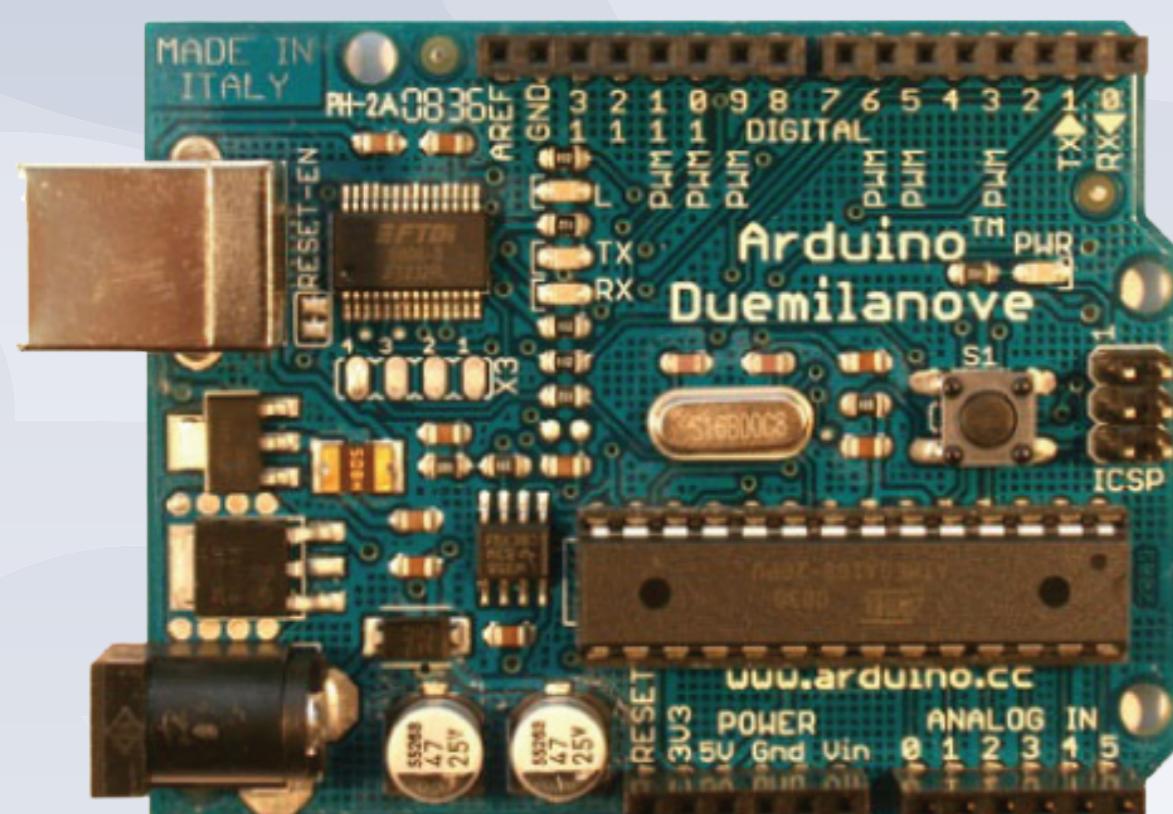
# Single-Axis Autopilot System

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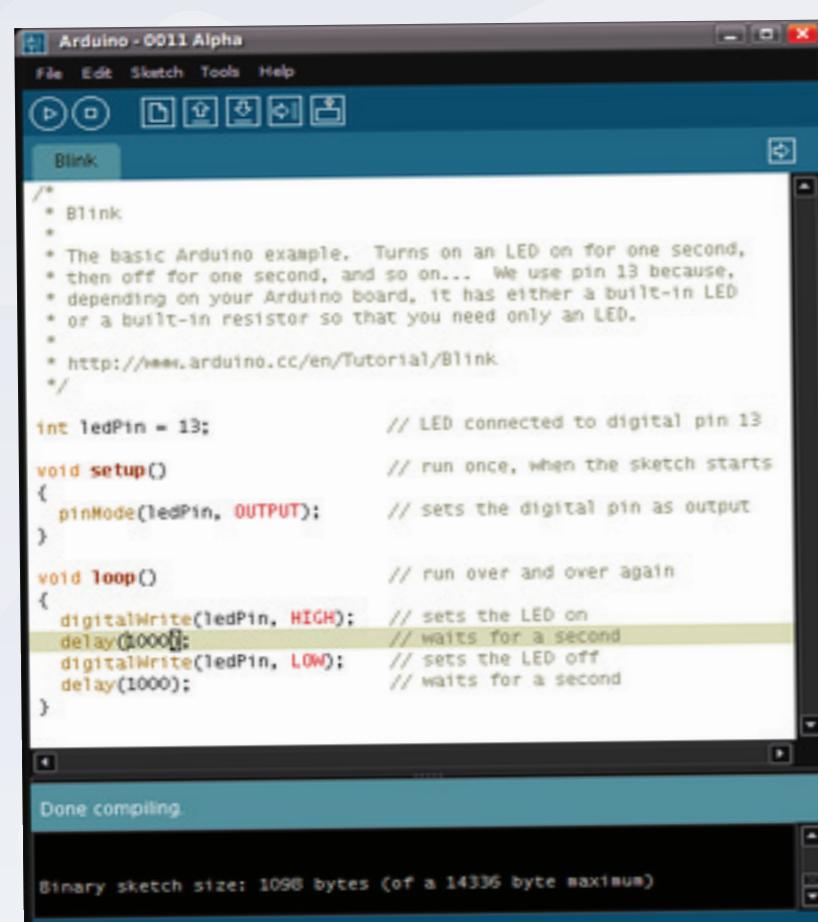
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## Introduction

The autopilot system is one of the most important systems in an aircraft and one that can reduce the work of the pilot significantly. Without it, the pilot will have to be alert for the entire trip. Long distance trips will be made near impossible. This project aims to learn and find out more about the autopilot system with the aerodynamics of an aircraft. We will investigate the operating principle of the control mechanism and its associated electronic circuitry. The control algorithm will be constructed and programmed to illustrate a wing level autopilot operation with the aid of a model aircraft mounted on a two axis motion platform.



The 'brain' of our system!



A screenshot of the Arduino IDE interface. The code window displays the 'Blink' example sketch. The code is as follows:

```
#include <Arduino.h>

void setup() {
    // initialize the LED pin as an output:
    pinMode(13, OUTPUT);
}

void loop() {
    digitalWrite(13, HIGH); // turn the LED on
    delay(1000); // wait for a second
    digitalWrite(13, LOW); // turn the LED off
    delay(1000); // wait for a second
}
```

The status bar at the bottom shows "Binary sketch size: 1098 bytes (of a 14336 byte maximum)".

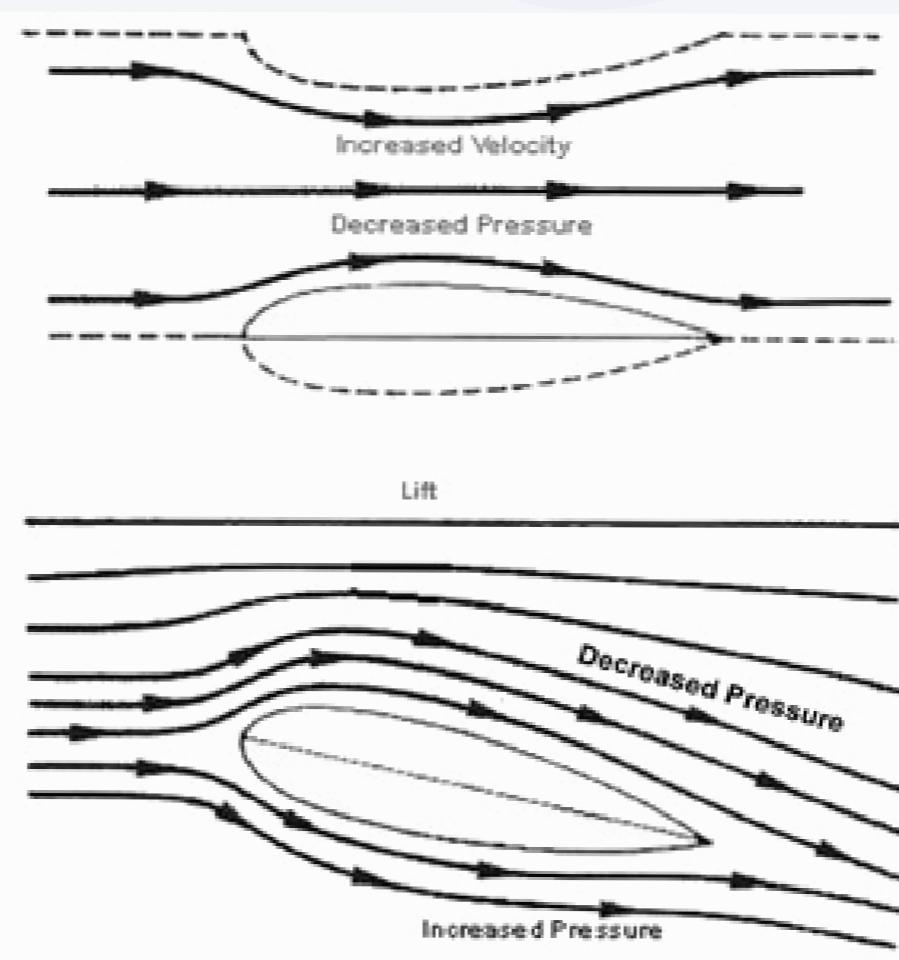
Code which runs the autopilot system.

## Methodology

The main component used was the *Arduino Duemilanove* microcontroller board. Others include the analog joystick, servomotors, accelerometer and an EPO foam RC plane. The soldering machine was used for the microcontroller board.

Using the *Bernoulli's Principle*, it states that the pressure of a fluid decreases as the speed of the fluid increases. Within the same fluid such as in air, high-speed flow is associated with low pressure, and low-speed flow is associated with high pressure. This applies to the generation of lift by a wing as the wings are designed such that air moves rapidly over its upper surface than its lower surface, thus decreasing pressure above the wings.

At the same time, the impact of air on the lower surface of the wing increases the pressure below the wings. This difference between the decreased pressure above the wings and the increased pressure below it produces lift.



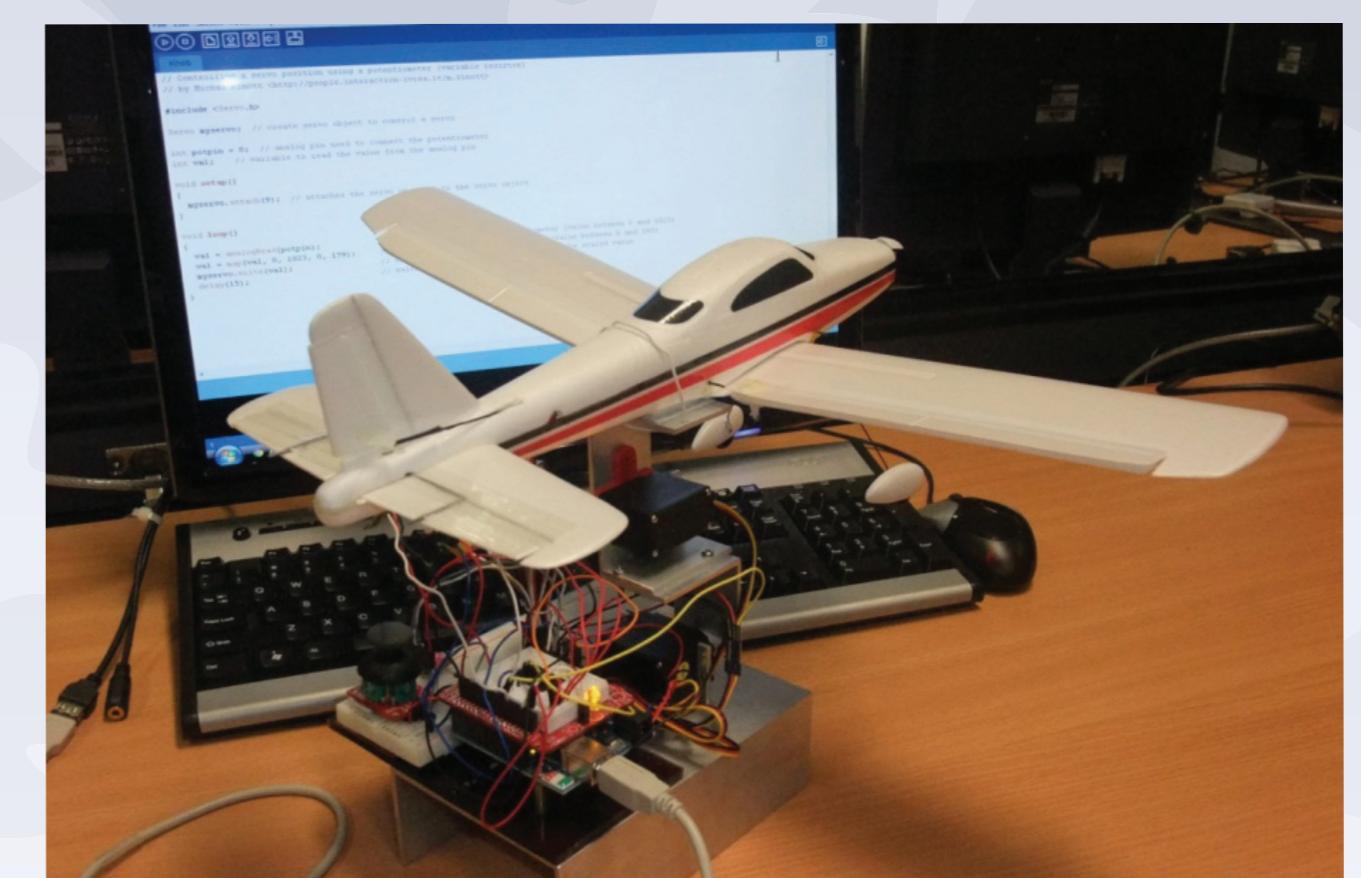
Concept of how plane mechanism works

## Results/Data

The autopilot can be disengaged by a push-button on the analog joystick and allows one to move the plane in the roll and pitch axis by manipulating the joystick.

A LED was fixed on the circuit to identify when the autopilot system was in operation.

When the autopilot is engaged, tilting the plane to a certain direction will result in the autopilot system kicking in and bringing the aircraft back to its wing-level position.



Model of autopilot system



Joystick that controls the plane

## Conclusion

The development of the Single axis autopilot system is an useful and highly successful way for modern aircrafts. Firstly, pilots would not have to take control of the aircraft at all times. Minor controls such as adjusting the plane according to different conditions such as air turbulence could be made by the system instead of the pilot. It minimises chances of human error made by pilots and can safely guide the plane to its destination without the control of the pilot. Without autopilot systems, it will be tiring for pilots to take control of the plane, especially for long distance travels. As such, it can only be concluded that the creation of the autopilot system has been a major landmark for the aviation industry and perhaps in the future, planes could be flown without having a need for pilots.