Touchdown Aviation and Efficient Power Generation Using LPWT for Airport Lighting Systems

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S. Muthukamala Priyadharshini

Abstract--- Energy harvesting by means of any source of energy become essential for the developing countries. Natural and renewable energy could provide clean environment to certain areas like airstrip (Run way).Mostly energy harvesting is achieved through wind source become seasonal and will have huge uncertainty in power quality. To overcome and to produce power without uncertainty with enhanced power quality, we would like to present a existing concept for a newer area with minimization. A low power, lower size wind turbine can be installed on both sides of the runway to require power. The power generation could provide clean energy and an important parameter called touchdown point of an air craft on the runway (air strip). The LPWT can be installed on both sides of runway to acquire power during aircraft landing and takeoff. Generally on runway, aircrafts movement will be around 400 nautical miles per hour. During the movement very great air velocity will occur on the runway and the same will be enough to drive small micro wind turbines to produce power. This power generated for the runway can also be used in the taxi-way and other purposes. The second concept is the touchdown point-which is the first point for the aircraft to touch the runway during landing.

Keywords--- Touchdown Methods, Piezoelectric Pads, Runway Excursions.

I. INTRODUCTION

The increase in demand for power has become more in day to day life. Rising in demand for electricity made the advancement in finding the alternative generation of power resources for the future generations. Energy harvesting system has become more essential for all the developing countries. There are many alternative energy resources like solar, wind and tidal which has become seasonal and during the uncertainties it is much more difficult to generate power with all enhanced power quality. This made the radical shift for the private organization to generate their own electric power as their business goals as a result of deregulation, open access, Privatization, is causing a significant review of network design and operating practices. The resultant safety measures discussed like the SLG (Safe Landing Guidelines) for finding separation of production, supply, bulk transmission, delivery (distribution), and metering into different businesses has sharpened the focus of these organizations. Power Quality (PQ) is also a major issue in the generation and there are also many challenges in developing new alternative power generation but maintenance can be done easily with the centralized method. Network control and automation will play a key role in enabling the network owners to adapt to the changing situation and opportunities to achieve generation of alternative power generation. To overcome the

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uncertainty to produce power the airport management has developed a new concept for power generation with new area miniaturization. Reducing energy demand is contrary to what both energy suppliers and governments have been doing during most of the modern industrial history. Whereas real prices of various energy forms have been decreasing during most of the industrial era, due to economies of scale and technology, the expectation for the future is the opposite. Previously, it was not unreasonable to promote energy use as more copious and cheaper energy sources could be anticipated in the future or the supplier had installed excess capacity that would be made more profitable by increased consumption.

II. RUNWAY EXCURSION

Runway excursions at landing is considered as a major threat to aviation safety as they account for approximately 25% of all incidents and accidents in air transport, and 96% of all runway accidents. While the occurrence rate of these events is very low, the entailed consequences may be very severe. A runway excursion can occur on takeoff or landing. It is defined as an event in which an aircraft departs from the end (overrun) or the side (veer-off) of the runway surface, sometimes with catastrophic consequences. There are multiple contributing factors to runway overruns, whose causes may begin as early as the approach briefing, or that may occur even once the airplane is on the ground and decelerating.

The types of runway Excursions are discussed which are focusing their efforts on reducing landing overruns and various safety strategies. Tailwind is the wind enhanced engine and flight performance also give the aircraft a greater safety margin, a factor that can be appreciated by aircrews.

The threshold speed from 50 feet above the ground level. ALD (Actual Landing Distance) is the point between 50 feet above the runway threshold. FDM (Flight Data Monitoring) are also used to monitor and analyze the risk evolved during the excursions.

The same factors appeared also as causes of overrun incidents, although with different relevance. Furthermore, these authors suggest three additional factors with high incidence for landing overruns:

- Long touchdown.
- High speed during approach.
- Presence of rain.

Runway excursions belong to the type of events occurring with very low probability but whose implications may be very severe. This constitutes an additional challenge for a risk analyst. Several international aviation organizations are focusing their efforts on reducing landing overruns, investigating various safety strategies. This variable could then be used as a runway excursion risk precursor, relevant information for airlines Flight Data Monitoring (FDM) teams.

III. TOUCHDOWN METHODS

HIDEC

Highly Integrated Digital Electronic Control (HIDEC) is the integration of aircraft engine operations with air data and flight control systems to improve aircraft performance. Research efforts led to the development of several control modes that demonstrated extended engine life, increased engine thrust, and lower fuel consumption. The major elements of HIDEC were a Digital Electronic Flight Control System (DEFCS), the engine-mounted DEECs, an on-board general purpose computer, and an integrated architecture allowing all components to "talk to each other."

Digital systems developed on the HIDEC F-15 were the adaptive engine control system(ADECS) and performance seeking control (PSC).It became the first aircraft to demonstrate the self-repairing flight control. blowing with a flight control system failure enough pitch, yaw, and roll authority to fly the aircraft until an airport is reached and a safe landing can be made. The PCA system was tested and initially demonstrated on the HIDEC F-15. It was later tested and publicly demonstrated on a three-engine MD- 11

jetliner. In simulator studies, NASA has also demonstrated the PCA concept on more than a dozen other types of system (SRFCS) and the propulsion-only flight control system (PCS).The integration of digital propulsion and flight control systems on military, commercial, and general purpose aircraft could lead to very significant savings in fuel, maintenance, and operational costs. The advantages of extended engine life enhanced engine and flight performance also give the aircraft a greater safety margin, a factor that can be appreciated by aircrews as well as passengers.

PCA (Propulsion Controlled Aircraft)

The Propulsion Controlled Aircraft System (PCA) was developed and flight tested at NASA Dryden commercial and military aircraft. The immediate benefit of a PCA system is having an emergency backup control system to avoid accidents because of control system failures. But PCA benefits reach beyond this basic safety feature. The PCA technology was later expanded to produce versions called PCA Lite and PCA Ultra lite that incorporate the engines only control concept for use in a variety of aircraft but at more moderate purchase and installation costs.

Dutch Roll Method

Dutch Roll is a method which uses damped oscillation in yaw of an aircraft that occupies into roll. Frequency similar to longitudinal short period mode, not as well damped (Less effective than Horizontal Tail). It is a type of Motion consisting of an out-of-phase combination of "Tail-Winging" and rocking from side to side which resembles a snake slithering in an effort to help pilots land safely when normal flight control components-elevators, rudders, and ailerons-are disabled because of major flight control system failures. PCA uses computer augmented engine thrust to give flight crews faced.

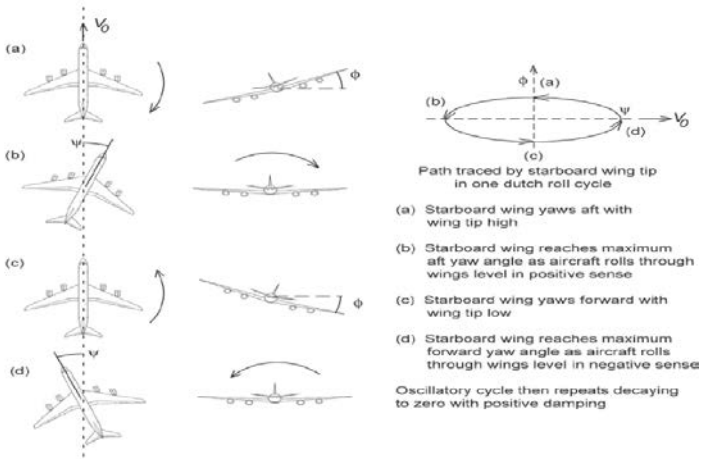

Figure 1: Dutch Roll Method

PROTECT (Propulsive Technique for Emergency Control)

This method is developed for the future aircraft design for emergency control using thrust to augment or replaces the flight control system. During the worst case situations this method is used along with PCA. The Airborne is the where the aircraft is carried through air which is near the ground surface and nearing the touchdown point. At this point, process of the communication system with the pilot must be very strong so that the aircraft can be safely landed.

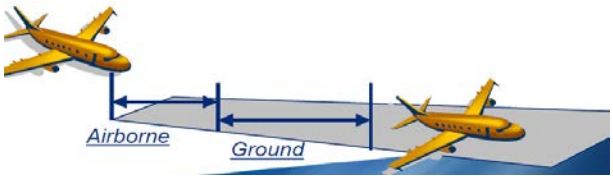

Figure 2: PROTECT Touchdown

GPWS (Ground Proximity Warning System)

A Ground Proximity Warning System (GPWS) is a type of equipment carried by aircraft to warn pilots if they are at a dangerously low altitude and in danger of crashing. It has the high sink rate warning system before 20 second of touchdown. The main purpose of these systems is to prevent what is called a **C**ontrolled **F**light **I**nto **T**errain (CFIT) is an accident in which an aircraft crashes into the ground, the water, or an obstacle such as a mountain or building.

IV. PIEZOELECTRIC PADS

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge. The prefix piezo-is Greek for 'press' or 'squeeze'.

Figure 3: Piezoelectric Pads

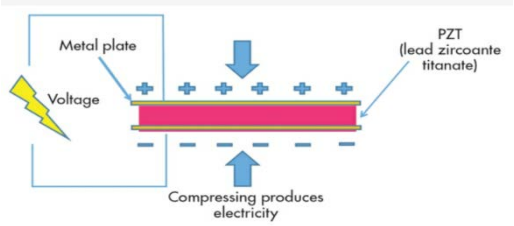

Figure 4: Piezoelectric Effect

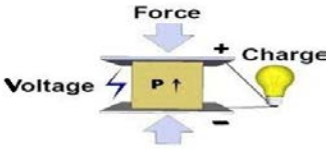

Figure 5: Electrical Representation of Piezoelectric Effect

Applications

- It has been successfully used in various applications such as in medical, aerospace, nuclear instrumentation, and as a tilt sensor
- It is used as a pressure sensor in the touch pads of mobile phones.
- In the automotive industry, piezoelectric elements are used to monitor combustion when developing internal combustion engines.

V. WIND TURBINE

A wind turbine is a device that converts the wind's kinetic energy into electrical energy. Wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging for auxiliary power for boats or caravans or to power traffic warning signs. Slightly larger turbines can be used for making contributions to a domestic power supply while selling unused power back to the utility supplier via the electrical grid. Arrays of large turbines, known as wind farms, are becoming an increasingly important source of renewable energy and are used by many countries as part of a strategy to reduce their reliance on fossil fuels. Wind was shown to have the lowest relative greenhouse gas emissions, the least water consumption demands.

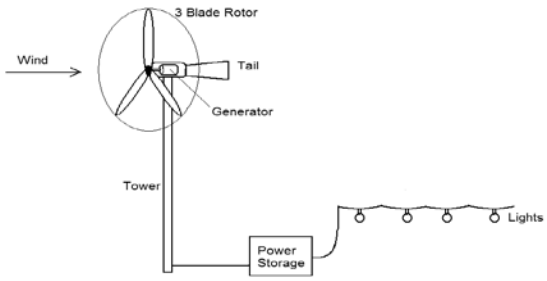

Figure 6: Wind Turbine

VI. MICROCONTROLLER (PIC16F877A)

In this system the PIC16F877A microcontroller is used. It is easy to use and very high speed compared to others. It has five ports, which includes two analog ports and three digital only. The port includes A.B,C,D and E. A and E-Analog or Digital, THE PORT B, C and D-Digital only Port A includes 6 pins, port B, C D includes 8pins port E includes 3pins. Automatic reset power ON reset will reset

the programs or commends when power is off and on. The PIC16F877A features 256 bytes of EEPROM data memory, self programming, an ICD, 2 Comparators, 8 channels of 10-bit Analog-to-Digital(A/D) converter, 2 capture/ compare/ PWM functions, the synchronous serial port can be configured as either 3-wire Serial Peripheral Interface (SPI™) or the 2-wire Inter-Integrated Circuit (I²C™) bus and a Universal Asynchronous Receiver Transmitter (USART). It have some features like 2 PWM 10-bit 256 Bytes EEPROM data memory, ICD, 25mA sink/source per I/O, Self Programming ,Parallel Slave Port.

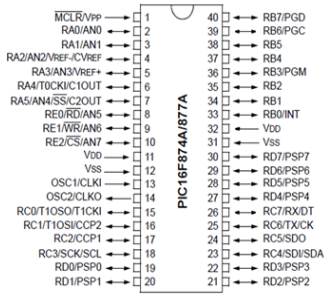

Figure 7: Pin Diagram of PIC16F877

VII. PROPOSED BLOCK DIAGRAM

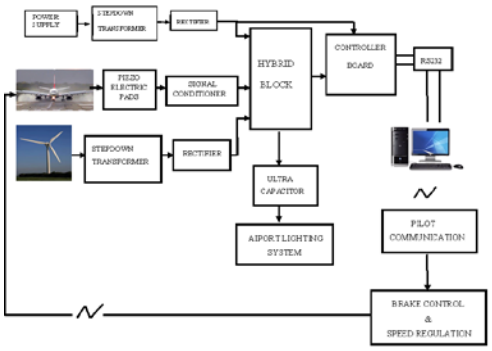

Figure 8: Proposed Block Diagram

The LPWT can be installed on both sides of runway to acquire power during aircraft landing and takeoff. Generally on runway, aircrafts movement will be around 400 nautical miles per hour. During the movement very great air velocity will occur on the runway and the same will be enough to drive small micro wind turbines to produce power. This power generated for the runway can also be used in the taxi-way and other purposes. The second concept is the touchdown point-which is the first point for the aircraft to touch the runway during landing. In the existing system the touchdown point is analyzed manually and communication between the pilot and monitoring room is very difficult to achieve on the runway which leads to angle deviation from the point. Improper monitoring of the touchdown point can lead to collision of aircraft on the runway. Existing communication system Aeronautical Mobile Airport communication System (AeroMACS) are done with the high rate and safety enhancing communication system in C-Band without getting accurate touchdown points. The proposed communication system that have covered all the future needs of Air Traffic Control (ATC) and Air Traffic Management (ATM) are controlled using the Embedded Micro Controller (EMC) and automated for achieving the exact point of touch down.

VIII. CIRCUIT DIAGRAM

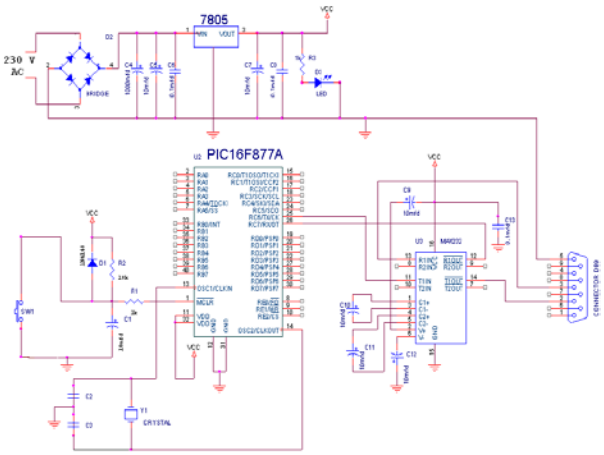

Figure 9: Circuit Diagram for Proposed System

The above circuit diagram is denotes the Touchdown Aviation and Power Generation using LPWT for Airport Lighting System.

IX. FRONT END

Visual Basic 6.0V

In Visual Basic 6.0, the Visual part refers to the method used to create the Graphical User Interface (GUI). As an substitute in writing numerous lines of code to describe the

appearance and location of interface elements, we simply add Pre built Objects in the required place on the screen. The Basic part refers to the BASIC (Beginners All- purpose Symbolic Instruction Code) language, used by many users than any other language in the History of Computing.

X. BACK END

Embedded

Embedded C is a set of language extensions for the C Programming language by the C Standards committee to address commonality affairs that extant between C extensions for different embedded systems. Historically, embedded C programming stand in need of nonstandard extensions to the C language in order to support tropical features such as basic input output operations, fixed-point arithmetic, multiple distinct memory banks.

XI. OUTPUT

Figure 10: Hardware Model of the Proposed System

Figure 11: Output of the Proposed System

XII. CONCLUSION

The concept can be evaluated and completely analyzed with the software used and also can be implemented in metro airports to achieve green and clean energy harvesting system with the self-powered runway with the automated touchdown zone. It uses touchdown sensors to automate the aircraft landing and power is generated with the pressure and impact from the vibration during landing. The efficient way of using the alternative source of power generation and which can be made with centralized distribution to all the other commercial and residential purpose from the power generated in airport. This project could have a complete solution for the existing system with the improved efficiency and automation for the social and safety welfare of the country

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