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Integrated Aircraft Landing System using Lidar And RSSI

B.Chinthamani, K.Kalaivani, K.R.Sughashini, P.Navaseelan, R.Nagalakshmi

Abstract*: An aircraft landing system is most essential to ensure quality air traffic and safe landing process. In most airports an advanced aircraft landing system is necessary. This project proposes a system wherein all departments functioning separately are integrated. This system will overcome disadvantages of the existing system such as slow landing process and possibilities of manual error. The project deals with developing an economical and affordable solution for perfect landing in airports based on physical ambient conditions in the airport. The proposed system continuously monitors all the physical parameters and sends an audio signal output in case of an abnormal condition. Various parameters which are required for safe landing such as air temperature, humidity, wind speed, wind direction, fog and visibility are measured using suitable sensors and interfaced to a controller unit. A Light Detection And Ranging (LIDAR) model is used to determine the ground level clearance. The distance of other aircrafts from the ground station is determined using Received Signal Strength Indicator (RSSI). A simulation output screen is used to continuously display the measured parameter values.

***Keyword* : Integration, Light Detection And Ranging(LIDAR), Received Signal Strength Indicator(RSSI).**

I INTRODUCTION

In this project, the parameters to be measured by the meteorological department such as airport temperature, humidity, wind speed, wind direction, fog and visibility are measured using respective sensors and fed to the parameter board through which the processed data is sent to the controller. The sensors used are infrared sensors and thermistors. A radar model is rotated with the help of a driver. This is used to detect the location of any nearby aircraft by measuring the received signal strength. A wireless transmitter is used to transmit the position of the aircraft from a joystick model which is received by the wireless receiver in the ground station. A microcontroller processes the data, compares with default parameter values and provides a voice signal output which is directed to the pilot to guide the aircraft's safe landing. A Light Detection and Ranging (LIDAR) instrument is also interfaced to the controller to determine ground clearance level in case of emergency landing. All the measured parameters are also continuously displayed on the simulation screen.

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* Correspondence Author
B.Chinthamani*, Assistant Professor (Sr.Gr), Department of Electronics and Instrumentation Engineering, Easwari Engineering College, Chennai, India
K.Kalaivani, Associate Professor, Department of Electronics and Instrumentation Engineering, Easwari Engineering College, Chennai, India
K.R.Sughashini, Assistant Professor, Department of Electronics and Instrumentation Engineering, Easwari Engineering College, Chennai, India
P.Navaseelan, Associate Professor, Department of Electronics and Instrumentation Engineering, Easwari Engineering College, Chennai, India
R.Nagalakshmi, Assistant Professor, Department of Electronics and Instrumentation Engineering, Easwari Engineering College, Chennai, India

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II OBJECTIVE

To continuously monitor the vital parameters such as Temperature, Humidity, Fog, Visibility, Wind speed, Wind direction and Position of aircraft and thereby present an economical and affordable solution for perfect landing of aircrafts based on physical ambient parameters prevailing in the airport with audiovisual indication output. The project will reduce the manual work in the existing system by processing all the values received and to provide an appropriate audio signal for safe landing.

A. Technical Background

This review was performed to find a better improved aircraft landing system. In the present system there are three essential departments that work simultaneously to ensure safe aircraft landing. They are the Meteorological, Mechanical and the Air Traffic Services departments. The above mentioned departments are installed at different locations where they work based on their own network, as well as share data for effective safe landing. This causes operating personnel to be continuously present in the ground station to monitor the value and enter the data manually which is later sent as audio signal to the pilot. The results of this review suggest that excessive manual work involved in the existing system emphasises on the need to develop an automated landing system.

B. Drawbacks of Existing Systems

- Essential areas of airports are not fully automated
- Slow landing process
- Possibilities of manual error
- Too many networks involved in landing

III PROTOTYPE IMPLEMENTATION

The various conditions required for safe landing is monitored and the separate departments are integrated using a microcontroller system paired with LIDAR and RSSI. The project consists of five modules as listed below.

- Data acquiring module
- Data processing module

- Data convertor module
- Data manipulator module
- Data communication module

In the **data acquiring module** the sensors play a major role as they act as an interface between the aircraft and ground station. Sensors such as thermistor, infra-red sensor (IR), light dependent resistor (LDR) are used to measure temperature, humidity, fog, visibility, ground clearance level. A DC fan is used to measure the wind speed.

In the **data processing module**, a parameter board is used to collect all the inputs from the sensors. Signal conditioning is done to remove unwanted frequencies and noise by usage of suitable capacitors and resistors. The raw data is thus converted into processed data through an analog process.

In the **data convertor module, all** the parameters are fed to the peripheral interface controller which processes data based on definite conditions written by user. ADC present inside the controller converts the input analog value to digital value. USART is used to convert these digital values to serial values. The serial values are fed to the computer by using RS232 serial port converter.

Data manipulator module is a software play using visual basic software. This module is a Graphical User Interface (GUI) module where the values processed by the controller are continuously displayed on the simulation screen and a voice output that gives a particular command is transmitted to the pilot.

In the **data communication module,** a wireless transmitter is used to transmit the position of the aircraft from a joystick model which is received by the wireless receiver in the ground station. The frequency used for this purpose is 433.93 MHz . Another wireless transmitter which is present in a nearby aircraft transmits a radio signal of frequency 430.33 MHz which is received by the wireless receiver present in ground station. Thus this wireless receiver measures the received signal strength of that aircraft.

1. PIC MICROCONTROLLER 16F877A

The 16F877A is a easy to perform powerful 35 single word CMOS 8-bit microcontroller with necessary features like 35 single word instructions, wide voltage range for its operation, high source and sink current.

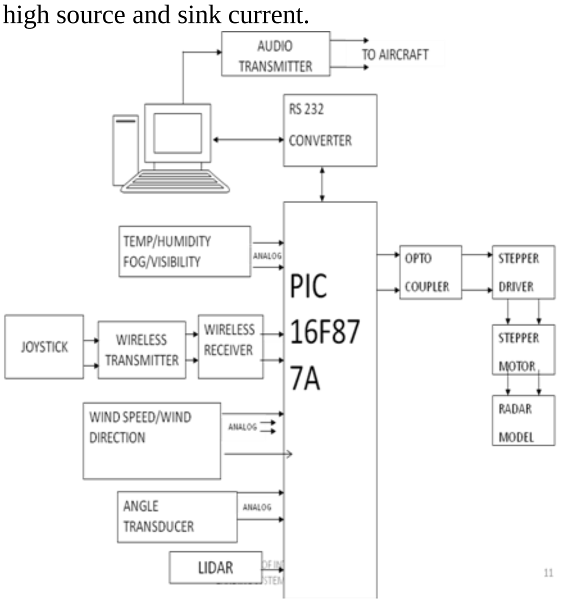

Fig.1.Block diagram of EMG based prosthetic limbs

Hardware components:

1. PIC Microcontroller 16F877A
2. Power Supply
3. MAX 232
4. Opto coupler
5. Sensors
6. Transmitter section
7. Receiver section
8. LIDAR and RSSI

2. POWER SUPPLY

Power supply units consist of 230V, 50HZ single phase AC power supply, which is reduced to 12V by a step down transformer, which is further rectified by Bridge Rectifier to obtain pulsating DC voltage. The pulsating DC voltage is further filtered with the aid of 2200 µf capacitor. For obtaining a fixed 5V supply, a 7805 IC is used. The PSU further consist of LED for indicating the presence of output voltage and for quicker capacitor discharge a RC time constant is added.

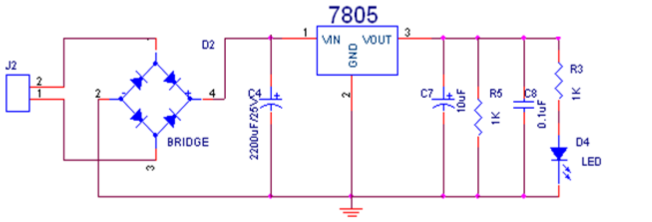

Fig 2.Power Supply circuit

3. MAX 232

The MAX232is an integrated circuit that converts signals from a RS-232 serial port to signal suitable for use in TTL compatible digital logic circuits.The MAX232 is a dual driver/receiver and typically converts the RX,TX,CTS AND RTS signals.The drivers provide RS-232 voltage level outputs(approximately 7.5 V) from a single 5V supply via on-chip charge pumps and the external capacitors. Thus the power supply circuit does not have to be complicated to just drive the RS-232. The receivers reduce RS-232 inputs(which may be as high as 25 V),to standard 5 V TTL levels. These receivers have a typical threshold of 1.3 V, and a hystersis of 0.5 V. The later MAX232A is backwards compatible with the original MAX232 but may operate at higer baud rates and can use smaller external capacitors-0.1 micro farad in place of the 1.0 micro farad used with the orginal device.

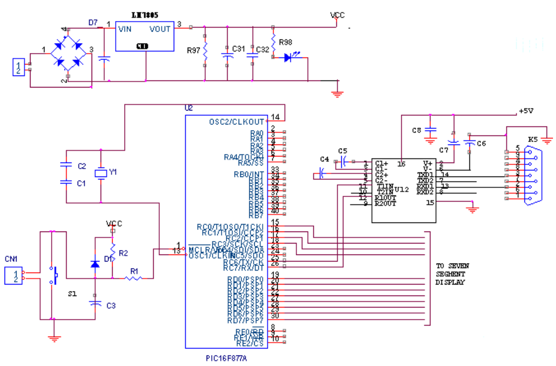

Fig 3. Circuit Diagram of Embedded Section(Power supply, PIC 16F877A and MAX232)

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4. OPTO-COUPLER

The optocoupler, also known as an opto isolator, consists of a photon-emitting device whose flux is coupled through a transparent insulation material to some sort of detector.

The photo emitting device may be incandescent or neon lamp (earliest models used these) or a LED. The transparent insulation may be air, glass, plastic or optical fiber. For the purpose of detecting the light an photo sensor can be used. The main objective of the optocoupler is to isolate dielectrically the input signal from the output signal. MCT2E is used as the optocoupler for isolating stepper motor circuit from the embedded circuit. Since we use stepper motor as the drive, it will generate back emf during the process of switching operation. To avoid these effect in this proposed work..

5. SENSORS

The sensors used for measuring various parameters in the project are thermistors, IR sensors and a Light Dependant Sensor(LDR). The thermistor used is made of Bismuth Oxide and is a bead type thermistor of range 0-225 degree Celsius. Thermistors are used to measure temperature (in deg Celsius) and humidity (in %). IR sensors are used to measure fog and visibility (in %) and have high accuracy and good sensitivity. LDR is used as the detector in the LIDAR model used. It shows a decrease in resistance as light intensity falling on it increases.

6. TRANSMITTER SECTION

A. JOYSTICK MODEL

A joystick model is used to indicate the position of the aircraft. It comprises of two potentiometers placed in a cross manner. 0 V to 5V can be varied across the length and breadth of the potentiometer. The change in resistance thus brought about is proportional to different voltages between 0-5 V. These voltages correspond to different positions shown on the simulation screen.The various positions possible in the joystick model are fed to an encoder HT12E via a PIC micro controller.

***B.HT12E* ENCODER**

The encoder which interfaces RF and infrared circuit is a 2^{12} series encoder which is paired with 2^{12} series decoder for perfect retrieving of signal. The encoder used here is a HT12E encoder which gives series output on receiving parallel inputs. Here a 12 bit parallel data is been converted into a serial output, which is further transmitted through RF transmitter. For the purpose of transmission, the 12 bit data is divided into 8 address bits each with 4 bits of data. The operation of HT12E is using simple, as like when a trigger signal is being received by the TE pin, the address / data are transmitted along with the header bits through RF or any infrared transmission sources. This process of transmitting signal by HT12E continues till the TE pin is kept low. Once the TE pin return to high state, the encoder completes its process of data transmission.

7. RECEIVER *SECTION*

The receiver section comprises of a demodulator and a HT12D decoder. The demodulator separates the message frequency from the carrier frequency and sends it to the decoder.

A. HT12D DECODER

This a decoder integrated circuit that belongs to 2^{12} series of decoders. It is mainly provided to interface RF and infrared circuits. They are paired with 2^{12} series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format. In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin.HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

8. LIDAR and RSSI

A. LIDAR (LIGHT DETECTION AND RANGING)

LIDAR is generally used to monitor ground clearance level. For this purpose a LIDAR model comprising of white LED as a source and a Light Dependant Resistor (LDR) as the detector is used. The light emitted from the source is reflected off the ground and collected by the detector. The time taken by the light to be received by the detector is used to find the distance of the aircraft from the runway.

B. RSSI (RECEIVED SIGNAL STRENGTH INDICATOR)

A wireless transmitter situated in each aircraft can send signals which could be obtained by the receiver present in the ground station .The wireless receiver will determine the received signal strength of each aircraft. The measured signal strength is used to determine the position of the nearby aircraft and guide the plane which has requested landing appropriately.

IV PROGRAM IMPLEMENTATION

A. PIC PROGRAMMING

One of the most useful features of a PIC microcontroller is that it is reprogrammable as it used flash memory. Instruction sets are the source codes that are written by the programmer for performing the desired operations in a PIC chip. These codes can be usually written in any of the programming languages such as C, C++, assembly languages, and so on. The instruction set commands are pre-determined for each and every function with its own command syntaxes and are executed by the PIC chip.PIC chips are normally use Reduced Instruction Set Programming that only contain 35 simple instruction sets that are much easier to learn by the programmer.

B. VISUAL BASIC SOFTWARE

The VB programming system packages up the complexity of windows in a truly amazing way. It provides simplicity and ease of use without sacrificing performance or the graphical features that make window such a pleasant environment to work in Menus, fonts, dialog, boxes etc are easily designed and these features require no more than a few lines of programming to control. It is one of the first languages to support event driven programming a style of program especially suited to graphical user interface. The aim in modern computer application is to have the user in charge.

Instead of writing a program that plots out every step in precise order, the programmer writes a program that responds to the user's action like choosing a command, moving the mouse etc. Instead of writing on large program, the programmer creates an application, which is a collection of many programs.

With VB such an application can be written with unprecedented speed and case.

V OUTPUTS

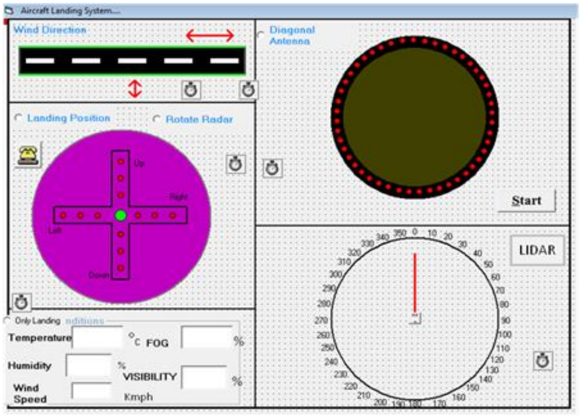

Fig 4: Simulation Result

Fig 5: Simulation Result of LIDAR

Table 1. Observation Table

S.NO	PARAMETER	RANGE	RESULT
1.	Temperature	>50 deg Celsius	Send "High temperature, pressure needs to be maintained"audio signal.
		<15 deg Celsius	Send "Low temperature, pressure needs to be maintained. "audio signal.
2.	Humidity	>80%	Send "High humidity due to rain "audio signal.
3.	Fog	>60%	Send "Dense fog, land with caution "audio signal.
4.	Visibility	>70%	Send "Poor visibility, wait for clearance. "audio signal.
5.	Wind Speed	>12Km ph	Send "High wind speed, vary accordingly. "audio signal.

The above table showcases the necessary ranges for which an audio signal as mentioned above has to be sent to pilot thus indicating the conditions of the airport for safe aircraft landing.

VI FUTURE SCOPE

The entire concept of the project started with an aim to reduce excessive manual work required to monitor and process each parameter in the airport. This system in particular, would be very useful to reduce manual errors and help in providing accurate information to the pilot for an effective aircraft landing. By implementation of this project we can also reduce the number of networks involved in landing of aircrafts in the existing system. This would be a small beginning for a better automated system in airports that facilitates both the ground station and the aircraft.

VII CONCLUSION

An effective system to continuously monitor the essential conditions in the airport such as temperature, humidity, fog, visibility, wind speed, wind direction and also the position of the aircraft was implemented using suitable hardware. A Visual Basic program is used to automatically process the data received and sends voice signal to the pilot informing him of the situation in the airport for safe aircraft landing. This system reduces the manual labour of entering data into the computer by the operating personnel thereby providing a better improved aircraft landing system with no room for any errors.

REFERENCES

1. C. S. Sharp, O. Shakernia and S.S. Sastry. (2001) 'A Vision System for Landing an Unmanned Aerial Vehicle', Proceedings of IEEE International Conference on Robotics and Automation, Vol.2, pp. 1720-1727.
2. Dale R. Patrick, Stephen W. Fardo. (2008) 'Electricity and Electronics Fundamentals', The Fairmont Press, Inc., Technology & Engineering.
3. M. K. Kaiser, N. R. Gans and W. E. Dixon. (2010) 'Vision-Based Estimation for Guidance, Navigation, and Control of an Aerial Vehicle', IEEE Transactions on Aerospace and Electronic Systems,Vol.46, Issue3, pp. 1064-1077.
4. www.authorstream.com/Presentation/Mathikasi-1915905-ils-mathivanan
5. www.airport-technology.com

AUTHORS PROFILE

Mrs.B.Chinthamani, studied M.E(Instrumentation Engineering) in MIT Chrompet,Chennai. Pursuing PhD in Anna University, Chennai. Research area is Renewable Energy sources. Published papers in many reputed Journals and Conferences.