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AIR TRAFFIC CONTROL USING SINGLE BOARD COMPUTER

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***Abstract*- Air traffic control plays a pivotal role in the operation of aircrafts in and around the country. The existing system has some flaws that causes inadvertent delays and poses severe security threats. Our project aims to counter the existing flaws by developing a single board computer and integrating it with sensors required to operate the aircraft smoothly and swiftly without compromising the security. The project aims to automate the landing system thereby eliminating the manmade errors. The main aim of using the single board computer is to speed up the process of aircraft landing. The computer used in the aircraft landing is strictly not used for any other purpose thereby eliminating attacks from intruders and hackers**.

***Keywords*-Air traffic control, delay, security, single board computer, sensors**

I INTRODUCTION

Air traffic control is most essential and required for the most modern airports to reduce down time of activities and to improve quality air traffic. We would like to integrate the existing system, which is widespread in the airports today and leads to misguiding of aircrafts.We would like to present an economic affordable solution for perfect takeoff and Landing System for airports with physical ambient conditions of the airport with audiovisual networking.We would like to develop angular position of the aircraft from mid of runway, demonstration of diagonal antenna function, Rotation technique of Radars, Landing angle of an aircraft, ambient parameters like Temperature, Humidity, Wind Speed, Wind Direction and much more.For audio, visual effects, multimedia will be used along with visual basic software. We would like to develop an auto pilot system during highjack time using communication analysis, delink of communication and reception of communication in other such base station.This project can be executed in two ways. One is integrating the PIC16F77A with PC through RS232 converter and the other one is integrating different sensors with a single board computer. We prefer the latter for its safety and security

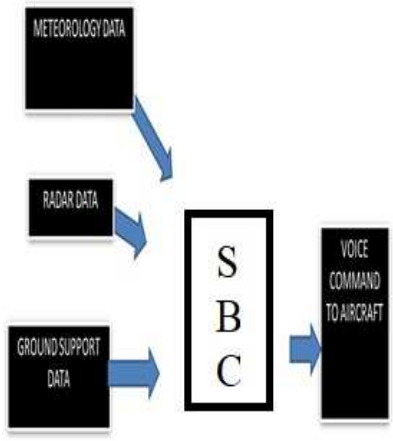

Fig 1 - Block diagram of air traffic control

Meteorology data and ground support data include measuring,temperature,visibility,humidity,fog,wind speed and wind direction. The above data is collected through various sensors and it is sent to the single board computer. The single board computer in turn sends the voice command to the aircraft. We intend to use Toradex single board computer for its easy customizability. Temperature and humidity parameter is measured using thermistor. Wind speed is measured using anemometer and wind direction is measured using ball clutch(reed).

Wind speed and direction

The following diagrams shows how wind speed and wind direction is measured.

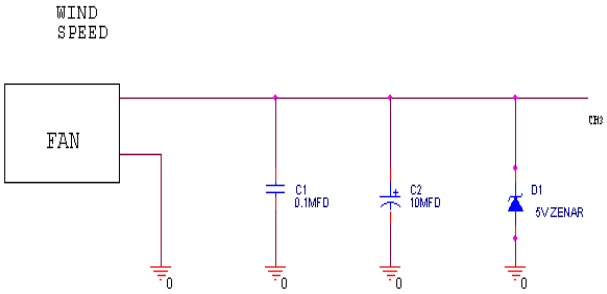

Fig 2- Wind Speed circuit

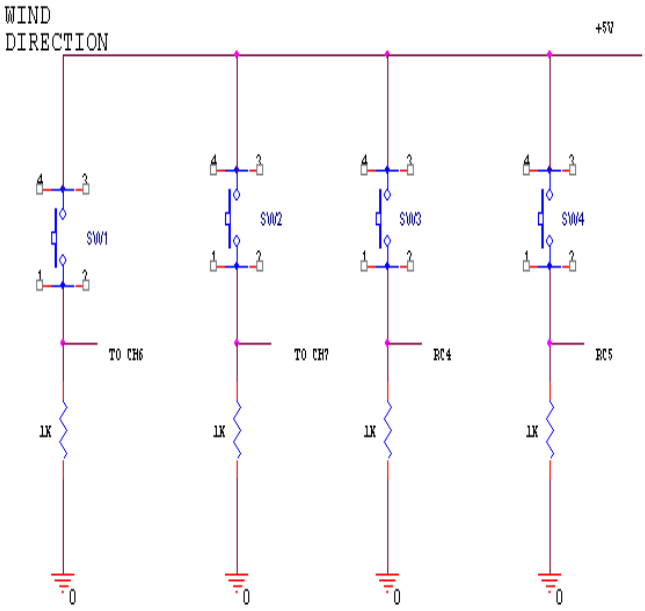

Fig 3- Wind direction circuit

An **anemometer** is a type of weather instrument that measures wind speed. Some of these instruments measure both wind speed and wind direction. **Anemometers** are common at weather stations. A cup **anemometer** is a type of instrument that uses three or four hemispherical cups mounted on horizontal arms on a vertical rod. Figure 2 shows how wind speed is measured. The speed of the wind rotates the fan and the rotation of fan varies the voltage. This voltage is subsequently converted to the speed of wind and is displayed. The circuit shown in Figure 3 is used to find the wind direction. The switches are connected to the PIC16F877A. Initially the output of the switches is low. When the wind blows in a particular direction the output of switch goes from low to high thus indicating the direction of wind.

II FOG AND VISIBILITY

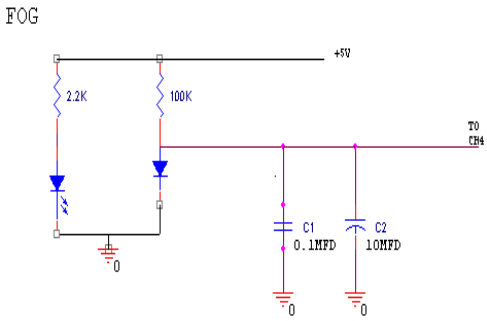

Fig 4- Fog and visibility circuit

Fog and visibility are two important parameters to be monitored. Fog is a measure of density of the snow fall.Itaffects the flight's path and makes it next to impossible to land the flight properly. So it becomes imperative that fog is monitored. We monitor fog with the help of circuit shown in figure 4. We have an IR emitter and IR detector. Rays passed from IR emitter is detected with the help of a IR detector. When the fog is more the rays passed from the IR sensor are not properly detected by the IR detector. The IR detector value is sent to the embedded system thereby monitoring the fog. The visibility is monitored the same way as fog with one difference. While monitoring fog IR sensor and detector is placed parallel to each other whereas while monitoring visibility, IR sensor and detector is placed adjacent to each other. Rays passed from the emitter gets deflected back to the detector in case of a disturbance in the flight's path. If the runway is clear the detector would not receive the emitted rays thereby not altering the voltage. Thus fog and visibility is measured.

Temperature and Humidity

Temperature is measured with the help of a thermistor. Though there are many methods available to detect the temperature we use thermistor for its low cost and easy implementation. The thermistor senses the temperature and it converts it into millivolts. The millivolts is then again converted into degree centigrade with manual calculation. For humidity measurement one thermistor is kept in water and other thermistor is kept in the room so as to measure the temperature of water and temperature of room respectively. The formula to measure humidity is

Humidity=(water temp/room temp)*100%

III PROCESSOR

To perform the various operations and conversions required to switch, control and monitor the devices a processor is needed. The processor may be a microprocessor, micro controller or embedded controller. In this project an embedded controller has been preferred because of its industrial advantages in power electronics like built in ADC, RAM, ROM, ports, USART, DAC. This leads to lesser space occupation by the circuit and also the speed of embedded controllers are more compared to other processors. The embedded controller selected for this project is PIC16F877A for its distinct features. As mentioned earlier, using PIC16F877A processor is one of the methods of achieving the goal of in a relatively easy manner.

Features of PIC16F877A:

- High-performance RISC (Reduced Instruction Set Controller) CPU
- Only 35 single word instructions to learn
- All single cycle instructions except for program branches which are two cycle. Operating speed: DC - 20 MHz clock input and DC - 200 ns instruction cycle,4K x 14 words of Program Memory (EPROM)
- 256 x 8 bytes of Data Memory (RAM)
- Interrupt capability (up to 14 internal/external interrupt sources)
- Eight level deep hardware stack
- Direct, indirect, and relative addressing modes
- 12-bit multi-channel Analog-to-Digital converter On-chip absolute band gap voltage reference generator
- Universal Synchronous Asynchronous Receiver Transmitter, supports high/low speeds and 9-bit address mode (USART/SCI)

The data from thermistor, anemometer, ball clutch,fog and visibility sensor is sent to the embedded system through which it is sent to the single board computer for display and voice command to the aircraft.

Single board computer (SBC)

The advanced and secure version of this project is executing the different parameters with the help of a customized single board computer. We use TORADEX single board computer for our project. This single board computer can be customized to create any embedded product with its ready to develop platform. To create a customized SBC we need a computer on module board for operating system development and a carrier module for integrating different parameters in a single embedded system. The operating system is programmed using angular java for its excellent performance and superfast development. The specifications of the Toradex SBC is as follows

- Product type: apalis, colibri
- Cpu clock speed: 2.2Ghz-806Mhz.
- Temperature: -40°c-85°c
- RAM: 128Mb-2Gb
- Flash: 512Mb-16Gb
- Connectivity: UART, Ethernet.
- Multimedia: Video encoder, VGA, HDMI, RGB

Simulation Results

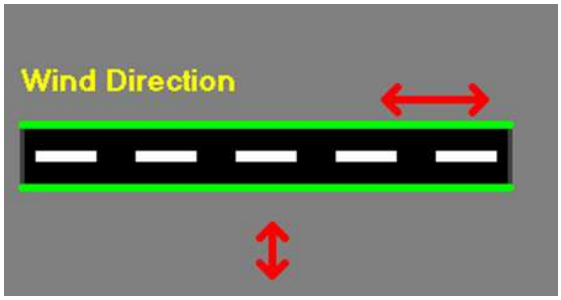

Fig 5- Wind direction output

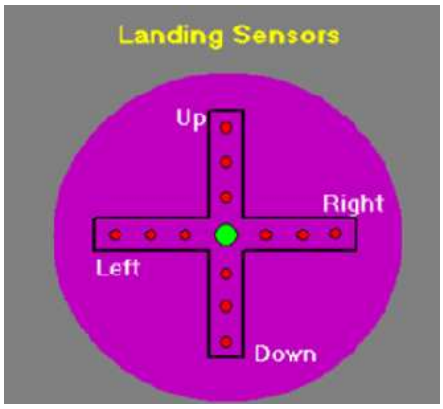

Fig 6- landing sensor output

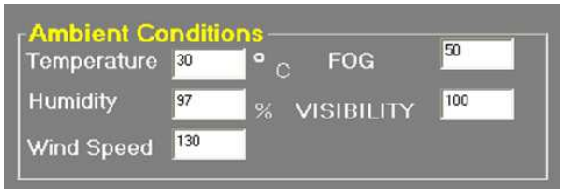

Fig 7- Ambient conditions output

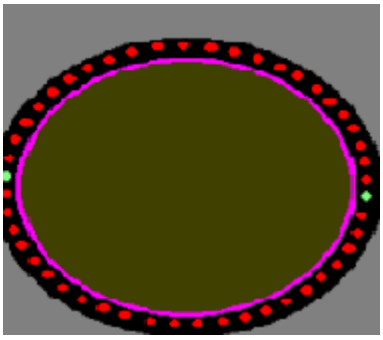

Fig 8- Diagonal antenna output

IV CONCLUSION

Thus the aim of the project to indigenously develop a single board computer for the purpose of air traffic control is achieved thereby eliminating safety and security threats and making the process faster and simpler than ever before.

V FUTURE SCOPE

Work can be done to reduce the cost of the project even further. A standalone system that is smaller and simpler than this project can be researched and developed upon. To meet the increasing security threats, the system has to be made more robust in the future.

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