



## CUSTOMIZE OS DEVELOPMENT FOR ADVANCED AIRCRAFT LANDING SYSTEM USING SINGLE BOARD COMPUTER TO AVOID INTRUSION

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**Abstract:** Advanced aircraft landing system is most significant & essential for all the airports, to reduce the downtime caused by communication between the modules and to increase the quality of air traffic. This project majorly deals with diagonal antenna function, rotation technique of radars & landing position of aircraft along with ambient parameters like temperature, humidity, wind speed, wind direction. For a real-time demonstration of the idea, embedded controller technology along with SBC (Single Board Computer) is used. Single board computer is used to avoid intrusion of the system. A dedicated Operating System is developed for landing position of aircraft and the automated voice note is generated to communicate with the aircraft.

**Index Terms** - Embedded controller, Single Board Computer, Aircraft landing System, Air Traffic Control

### I.INTRODUCTION

In airport, Air Traffic Control plays a major role to communicate with the aircraft, ATC guides the aircraft through the controlled airspace. Automatic Advanced Landing System 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. This papers presents an economic affordable solution for perfect Landing System for airports with physical ambient conditions of the airport with audiovisual networking. While landing ATC gives instruction to aircraft where (which runway) and when it has to land. It gives information to the aircraft about the weather of the airport, exact location of the aircraft. It gathers data from various departments Radar control, Climatology (Metrology), Ground support. The responsibility of ATC is to analyze the aircraft's perfect position and put into the right path for safe landing. An Automated system to be developed to increase the speed of information sharing between various departments of Airports (Radar control, Climatology (Metrology), Ground support, Air Traffic Control). The above all to be connected to a single automated system with a single page application suitable for wireless transmission to be developed.

#### 1.1 MOTIVATION

Aircraft landing system or Instrument landing system there are four departments involved that are the Metrology (Weather), Radar (Flight position angle of sky), ATC (Analyzer and communication to Aircraft), GSD (Runway, taxiway organization). In the existing system all the mentioned departments are located has different systems. The objective of the system is to integrate all the mentioned systems as a single unit. To increase the speed on governing, communication and to reduce network downtime though various technologies introduced on the Air Traffic Control, that all involves many computers involvements. When for a single work, if many computers involves a time delay cannot be removed. One new embedded automated system will solve all these issues.

1. Network delay.
2. Hack able system (It leads to an ATC system Hacking).
3. Delay due to multiple computer OS.

4. The multiple GUI screen makes panic

## 1.2 PROPOSED SYSTEM

The proposed system is a single OS based system that connects all the essential parameters on a single board computer and processed for high speed connectivity between climatology, Radar info, Ground Support, ATC information. Raspberry pi is used to develop the module. It is a complete computer built on a single circuit board. Single Board Computer has the several advantages over microcontroller and personal computer, like fast data acquisition, compactness, accuracy and virus free. It has some inbuilt I/O ports to connect the peripheral devices like Monitor, Keyboard, and ALS kit. Input will be given to the Single Board Computer and output of SBC connected to the computer monitor, computer monitor here used to monitor the data, which are all, acquired from an ALS kit by Single Board Computer.

## 1.3 DOMAIN INTRODUCTION

Single board computer or system on module is a complete computer built on single circuit board, with input or output ports microprocessors and other functional computer features. Single board computer are used to make demonstration systems for educational researches. Single board computer is a subtype of embedded systems since both hardware & software components are combined and executed concurrently. These systems are named as embedded systems has they are designed to perform specific functions which are interfaced directly with the environment as opposed to computer systems which interface only with the end-users. Single board computers are mostly used in fields of medical equipment, avionics, and networking and communication systems. There are many benefits of using single board computer products instead of full-stack development .These benefits includes easy for mass production, cost efficient ,reduction in risk, reduced time for customer design & requirements ,and the ability to develop customized OS.

## II. SYSTEM ARCHITECTURE

A system architecture or systems architecture is the conceptual design that defines the structure and/or behavior of a system shown in Fig 1.1. An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. Single Board System gathers all the data from various departments of airport like Radar, GSD (Ground Support Data), Metrology Data. Customized OS will be developed in the single board system that process all the data and send the automated voice command to the airport. The single page application will be developed with better GUI helpful to understand the data.

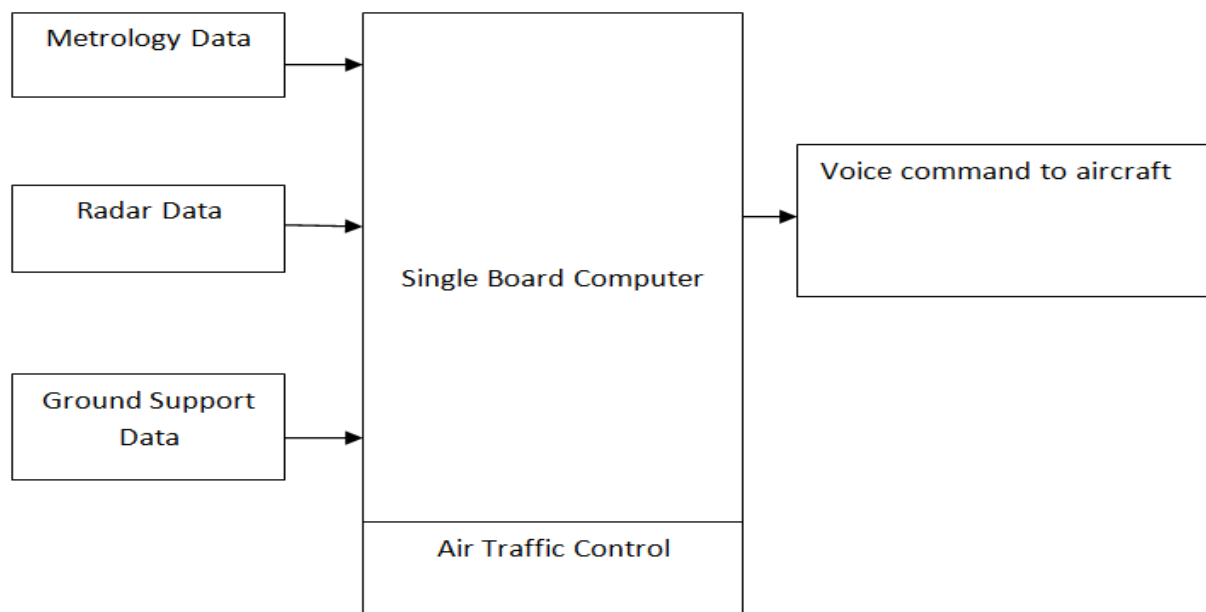


Fig 1 System architecture

### **III. DATA MODULES**

#### **3.1 METROLOGY DATA**

Metrology data plays a vital role in aircraft landing system. Aircraft landing takes place only when values of the parameters like Temperature, Relative Humidity, Speed, Wind Direction, Visibility and Fog are all in their corresponding habitat.

- **Airport Temperature:** The real problem with flying in hot temperatures is similar to the problem faced in high altitudes: thin air. Hotter air is less dense, which means there is less air beneath the wings for lifting the aircraft and less air to flow through the jet engines
- **Wind Speed:** Strong winds can be dangerous for planes trying to take off or land. It is been said that the biggest problem is head or tail winds that can affect the overall speed of an aircraft at a time when its speed is critical for a safe take-off or landing. "If you have a plane landing and coming in at over 100 mph, and a sudden strong wind hits the aircraft from behind, it can slow the effective airspeed of plane down considerably," Sosnowski said. The change in airspeed could cause the plane to stall.
- **Wind Direction:** There is a constrain for aircraft landing, i.e., landing should take place in opposite to the wind direction & the speed in the airport should be less than 25 Km/hr.

#### **3.2 RADAR DATA**

Radar is an object detection system that uses radio waves to determine the range, angle or velocity of aircraft. A radar system consists of transmitting antenna, a receiving antenna (often same antenna is used for transmitting & receiving) The rotation speed of radar is 12.5 -13.5 rpm (International Standard Speed). The radar rotating at this speed collects their Geo position in air. The collected data then fed to ATC for decision-making following shows the radar coverage range.

- **Airport Loop (Range):** Covers 18nm
- **Radar Loop (Range):** Covers 200km

### **IV. SENSORS INVOLVED**

The parameters are Temperature and humidity, Wind speed and direction, Fog and Visibility. Sensors involved to measure these parameters would be Thermistor (Temperature and humidity), Wind speed (Anemometer), Wind direction Ball clutch (Reed), Fog and visibility (IR sensors).

#### **4.1 THERMISTOR**

In industries various types of temperature detection are available, like thermocouple, RTD'S and Thermistors. Each of these sensors having some unique characteristics based on the applications and differs from one another. When we use THERMOCOUPLE which is based on "see back effect" required a cold junction compensation, which is expensive processed and have poor linearity. The next one is RTD having highest linearity but has disadvantages in vibrations and very expensive because this is made up of Platinum. The third one and implemented in our project is THERMISTOR (THERMAL RESISTOR) which comes under passive transducer classification. Thermistor finds wide applications and advantages. Here we mention some of it.

1. Fast response.
2. Smaller in size.
3. Rugged. (Not affected by shock and vibration)
4. Good sensitivity.
5. Low cost.

A thermistor is a temperature sensor constructed of semiconductor material that exhibits a large modification in resistance in proportion to a tiny low modification in temperature. Thermistors are inexpensive, rugged, reliable and responds quickly. Because of these qualities, thermistors are used to measure simple temperature measurements. Thermistors are easy to use, cheap, durable and respond predictable to a change in temperature. A thermistor is a temperature sensitive resistor, its resistance is depends upon temperature. When temperature changes, the resistance of the thermistor change in a predictable way. The benefit of using of thermistor is accuracy and stability.

## 4.2 ANEMOMETER

Anemometer is a instrument that measures windspeed and wind pressure. Anemometers are important tools for meterologists, who study weather patterns. The most common type of anemometer has three or four cups and attached to horizontal arms. The arms are attached to a vertical rod. As the wind blows, the cups rotate, making the rod spin. The anemometer counts the number of rotations or turns which is used to calculate wind speed, it counts the revolutions made by windmill blades.

Anemometers are used at almost all weather stations from the frigid arctic to warm equatorial regions. Wind speed helps to indicate a change in weather conditions such as an approaching storm, which is important for pilots, engineers and climatologists.

## 4.3 WIND SPEED

It is used for wind speed. Wind speed is measured by the rotation of the fan. When fan is rotated, the voltage is varied, that varying voltage is displayed which is like that speed of wind.

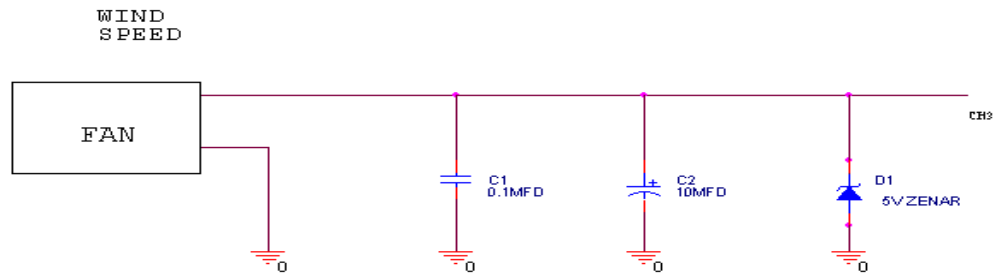


Fig 2 Wind Speed

## 4.4 WIND DIRECTION

This circuit is used for wind direction. In this project wind direction just like that simulation. Actually this switching operation is low to high transaction. Switching output is connected to PIC and initially output is low when switch is operated, its output is changed low state into high state. Then the output is monitored in PC

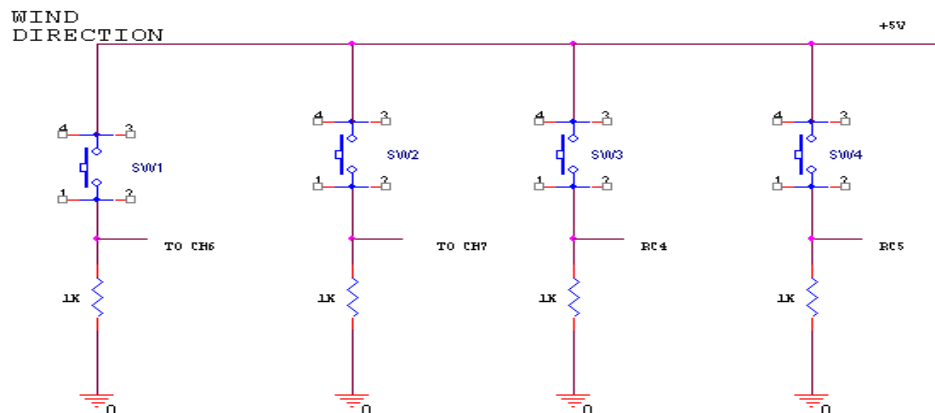


Fig 3 Wind Direction

## V. SINGLE BOARD COMPUTER

A SBC (Single Board Computer) is a full computer built on a single circuit board with microprocessor, I/O port, memory and other interface port. Unlike computer, single board computer do not have expansion slots. It allows us to develop a customized operating system which can run a desired application. **Raspberry PI Single Board Computer** is used for this project. A single board computer becomes customizable only if the corresponding carrier board interfaces with its computer on module. Figure 4 shows that the how to create a customized single board computer.



Fig 4

### 5.1 COMPUTER ON MODULE

Computer on module it is a type of the SBC. This is extended from the concept of system on chip as well as system in package it also called as the system on module, Computer on module connects with baseboard or carrier board which help full to make the interface between peripherals and computer on module. Figure 5 shows the computer on module

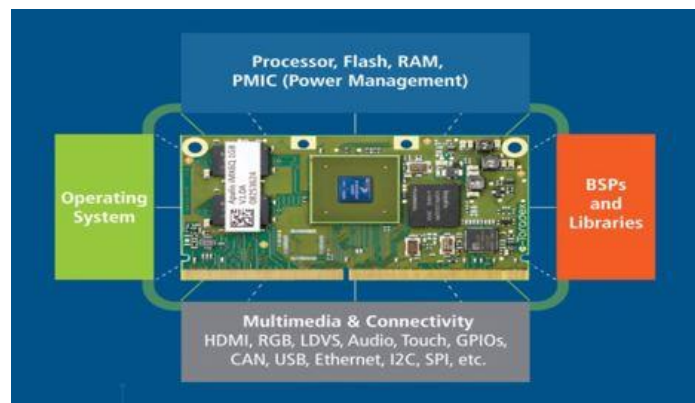


Fig 5

Computer on module has a microprocessor, Flash, Ram, Multimedia connectivity to make the interface and BSP's and Libraries. BSP stands for the Board support package toradex BSP is one of the most advanced available on the market, it helps the developer to create necessary applications in the COM. It has the pre-installed drivers, unlike PC we no need to install drivers for each peripheral. We use the Colibri PXA320 model for this project figure 6 shows the block diagram of Colibri PXA320 block diagram,

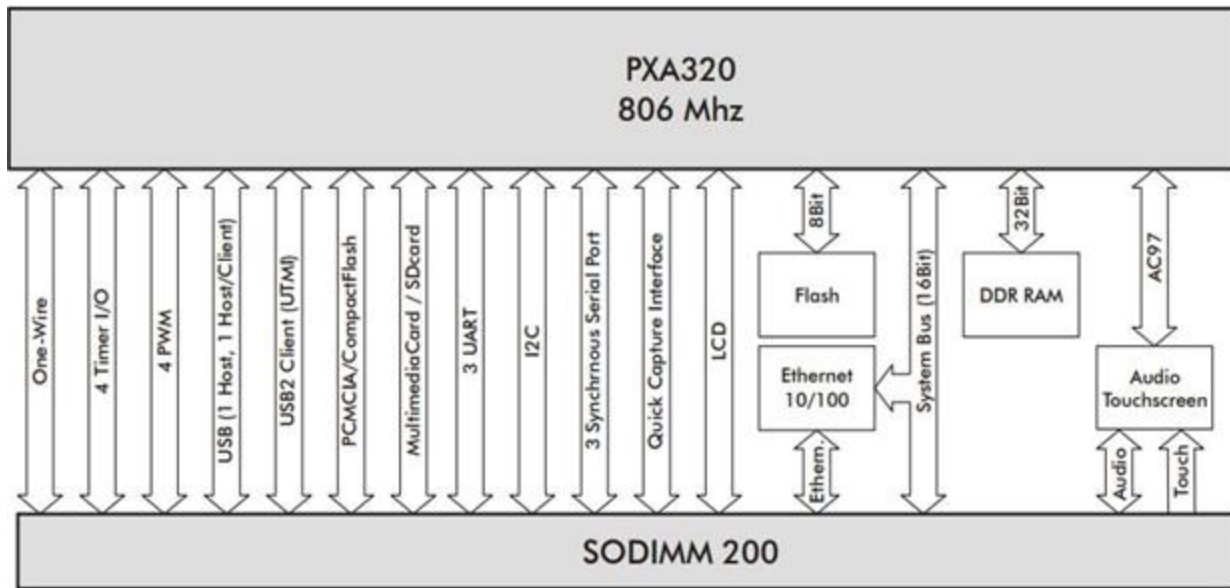


Fig 6

SODIMM 200, it means small outline dual in-line memory module, it's an alternative to the DIMM, SODIMM pin is interfaced with the carrier board and establish the connection between computer on module and carrier board. SO-DIMM needs less power voltage when compare to the DIMM.

## 5.2 CARRIER BOARD

Carrier Board is used to make a connection with Computer on module or System on module the carrier board houses the application-specific connectivity and multimedia interfaces such as USB, Ethernet, UART, HDMI, etc. The carrier board connects with the computer on module through the standard connectors like SO-DIMM or MXM. Figure 7 shows that the carrier board which we used in this project,



Fig 7

The customized single board computer is a combination of both computers with the module and the carrier board, Customized SBC offers a complete development platform. Carrier board available with various multimedia ports. Figure 8 shows the block diagram of carrier board and how it communicates with computer on module. Figure 9 shows the how to connect the carrier board and the computer on module.

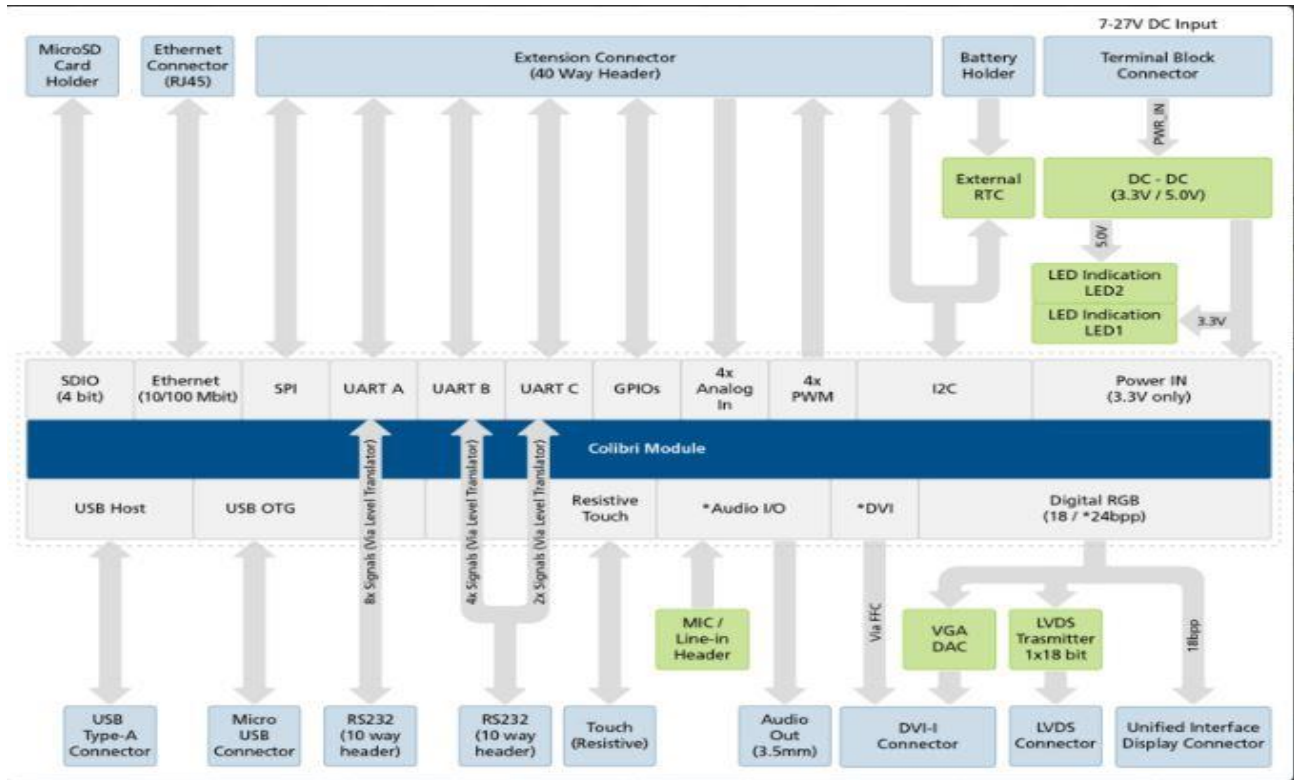


Fig 8

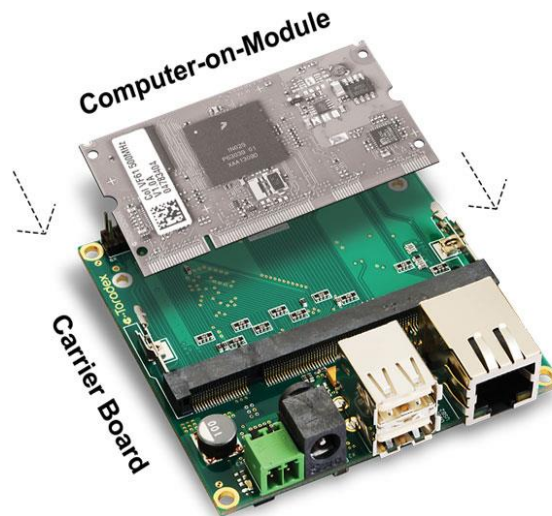
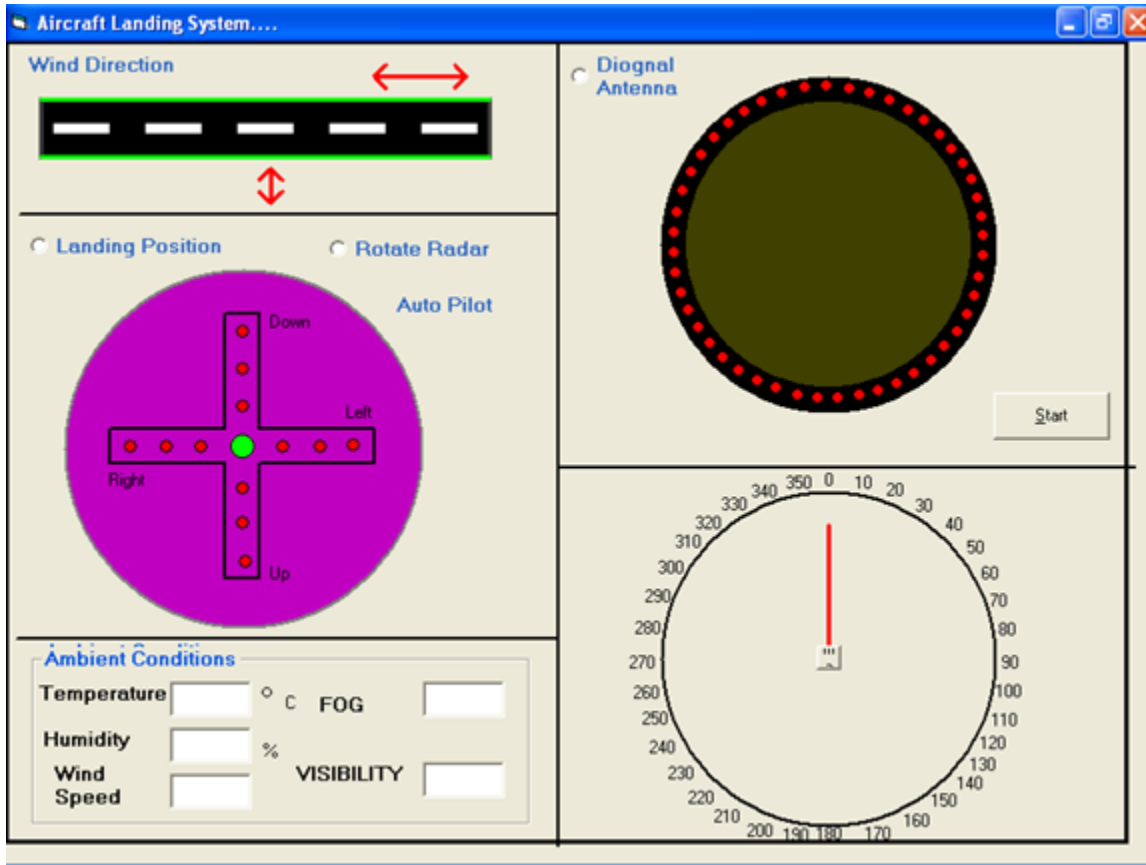


Fig 9

## VI. RESULT

Front end Single page GUI is created using Visual Basics, to show the processed data and to send voice command to the aircraft.



## VII.CONCLUSION

This paper briefly describes about the role of the Air traffic control and various sub departments involved in it. Further it also gives the major idea about single board computer. Customize operation system development for the Aircraft landing system overcomes the major difficulties of today's avionics system, and gives the intrusion free system .Usage of SBC for landing position reduces network delays along with safety.

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