

## Automated airfield controller system for avoiding air crashes in runway

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**ABSTRACT :** This work is an attempt to develop an advanced technology in airport control systems. As the existing system is manually operated, it is difficult to find solutions for some unexpected problems, for example: fire accident, ice, rain, fog and snow which may occur on the runway during the landing of the flight, which leads to air crashes in the runway . To take protective measures, introducing an automatic system to detect whether the runway is safe before landing the flight and this system also takes protective measures until the flight completely stops in the Airport. GPS (Global Positioning System) is used for inform the user to about exact location of the landing zone in the runway. Stepper motor is used as barrier system to control entry for vehicles and human. Zigbee transceiver is used as wireless communication protocol between aircraft and airfield controller system.

**Keywords** - Microcontroller, infrared sensor, Light Dependent Resistor, Gas sensor, Stepper motor, GPS (Global Positioning System).

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### I. INTRODUCTION

This project is mainly proposed for accident avionics. In recent years, lots of plane crashes were happened because of poor weather conditions and miscommunication between ground station operator and pilot. Because of poor weather, the pilots will lose their runway visibility, so the planes are landed in improper way which leads to a big crash.

Runway incursions can occur when there is a breakdown in communications or situational awareness at an airport. They can be caused by pilots, air traffic controllers, vehicle operators, or people working on an airfield, regardless of their level of training or experience. A general lack of situational awareness of their surroundings or confusion about their own position on an airfield seems to be the most prevalent cause of vehicle runway incursions. This can be due to a lack of training, misunderstanding or inattention to, airport layouts changes to an airport layout due to construction, Miscommunication is also a common cause for runway incursions, whether it is due to poor radio protocol, nonstandard wording, or a squelched message.

#### 1.1 Statement of aircraft landing Problems

Obstacles such as runway vehicle, pedestrian, fire accident, rain, fog or snow which occurs on the runway causes air crashes due to poor weather condition and improper communication between ground station operator and pilot. It is difficult to find out safety runway for aircraft landing. This is tackled by the development of automated airfield controller system to avoid air crashes in runway.

#### 1.2 Objectives

- To develop an intelligent, user friendly automated runway and airfield controller system which reduces manpower and air traffic congestion. Global positioning system is now one of the wide technology used for various field like navigation, aeronautics, automobiles etc.
- To develop a prototype of automated runway and airfield controller system using with ARM7 microcontroller to identify whether the runway is safe before landing the flight and this system also takes protective measures until the flight completely stops in the Airport.
- To replace human intervention by introducing fully automated system to provide safety and secure runway for aircraft landing

#### 1.3 System Overview

Air field controllers are autonomous systems which functions as an Air Traffic Controller. This work has two modules with different control systems between aircraft and airfield. It is easy to find solutions for some unexpected problems and to take protective action over the problems.

### 1.3.1 Airfield Controller Module

- The first segment introduced is GPS which indicates which runway is to be selected in a particular airport. GPS data will send to the aircraft.
- The Second section is pilot activated lighting (PAL) System. Based on GPS input Pilot will enable the PAL for respective (one based on GPS data and two coordinates pre-programmable) runway. airfield controller will control the full lighting system
- The third section the fire and safety system. This system is used to extinguish fire and explosions due to plane crashes in are runway.
- The fourth section is the runway dust alarm system. When more dust is deposited on the runway. This system is used to give information about the dust deposition.
- The fifth section is arrester barrier system is used to prevent vehicle to the runway which is in use.
- Tran receiver Module, It has to transmit the GPS data and ATC frequency data to the Aircraft Module. It has to send the run way information and it has to receive the data from aircraft module.

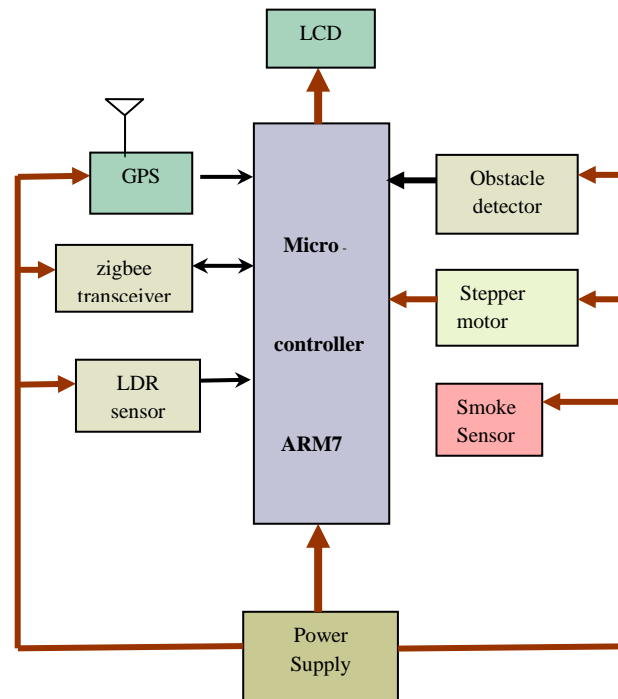


Fig.1.3.1 Block diagram of airfield controller system

### 1.3.2 Aircraft Module

This module will receive the data (GPS) from the Airfield controller module. Then it will display number of run ways available in the airfield. Then pilot will select the run way, based on selected runway airfield controller module enable the lighting system, fire & safety System, arrester barrier system. This system needs modules for displaying the run way information, selecting the runway and data communication in the airfield.

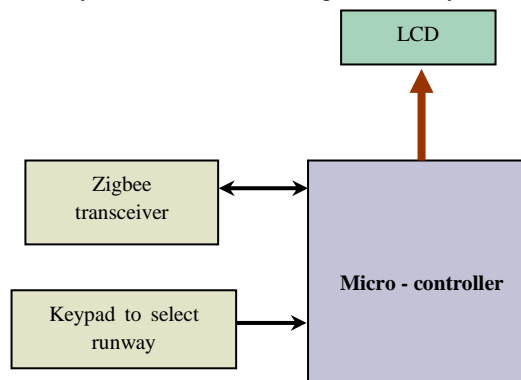


Fig.1.3.2 Block diagram of Aircraft Module

## II COMPONENTS DESCRIPTION

### 2.1 HARDWARE PART

#### 2.1.1 Microcontroller

ARM7 is a 32-bit reduced instruction set computer (RISC), instruction set architecture (ISA) developed by ARM Holdings. It was known as the Advanced RISC Machine. The ARM7 architecture defines basic debug facilities at an architectural level.

The LPC2148 is based on a 16/32 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, together with 128/256 kilobytes (kb) of embedded high speed flash memory. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at maximum clock rate. For critical code size applications, the alternative 16-bit Thumb Mode reduces code by more than 30 % with minimal performance penalty. With their compact 64 pin package, low power consumption, various 32-bit timers, 4-channel 10-bit ADC, 2 advanced CAN channels, PWM channels and 46 GPIO lines with up to 9 external interrupt pins these microcontrollers are particularly suitable for automotive and industrial control applications as well as medical systems and fault-tolerant maintenance buses. With a wide range of additional serial communications interfaces, they are also suited for communication gateways and protocol converters as well as many other general-purpose applications.

#### 2.1.2 UART

Universal Asynchronous Receiver / Transmitter are used in serial communication between two devices in conjunction with RS-232. Normally, we use 9600bps as the standard baud rate with 1 start bit and 1 stop bit in this communication.

#### 2.1.3 Stepper Motor

Stepper motors provide a means for precise positioning and speed control without the use of feedback sensors. This is used as a barrier system in the runway to prevent the entry for vehicle and humans.

#### 2.1.4 Light Dependent Resistor

LDR is a resistor whose resistance decreases with increasing incident light intensity. It can also be referred to as a photoconductor. Two cadmium sulphide photoconductive cells with spectral responses similar to that of the human eye. The cell resistance falls with increasing light intensity. It is used to test light intensity in the runway varied from rain, fog and smog. LDR produces analog values which can be converted into digital values by ADC which is inbuilt with microcontroller.

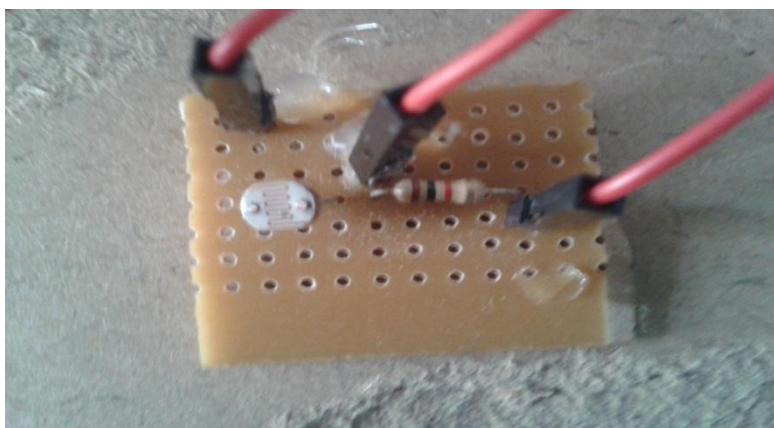


Fig.2.1.4 Light Dependent Resistor

#### 2.1.5 IR Sensor:

IR Sensor also referred as obstacle sensor. Infra Red light is electromagnetic radiation with a wavelength between 0.7 and 300 micrometers, which equates to a frequency range between approximately 1 and 430 THz. Infrared light has a longer wavelength (and so a lower frequency) than that of red light visible to humans. It is used as the airfield controller to detect the obstacles found in the runway to avoid the crashes.



Fig.2.1.5 Infrared sensor

### 2.1.6 Combustible Gas Sensor

Used in gas leakage detecting equipments for detecting of LPG, iso-butane, propane, LNG combustible gases. The sensor does not get trigger with the noise of alcohol, cooking fumes and cigarette smoke. It is used to sense any fire, smoke and gases found in the runway during the landing.

### 2.1.7 Zigbee transceiver

The zigbee communication is a communication technology to connect local wireless nodes and provides high stability and transfer rate due to data communication with low power consumption. Zigbee is one of the most widely used transceiver standard in wireless sensor network. Global operation in the 2.4GHz frequency band according to IEEE802.15.4

### 2.1.8 Global Positioning System

The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides reliable location and time information in all weather and at all times and anywhere on or near the Earth. GPS is used for longitude and latitude position of the runway, for providing safe landing of the aircraft.

## 2.2 SOFTWARE REQUIREMENTS

### 2.2.1 Keil Micro Vision.

Keil Micro vision combines project management Make facilities source code editing, program debugging and complete simulation in one powerful environment. The Microvision development platform is easy-to-use and helping you quickly create embedded programs that work. The Micro vision editor and debugger are integrated in a single application that provides a seamless embedded project development environment.

### 2.2.2 Embedded C.

Embedded C is a set of Language extensions for the Programming Language by the C Standards Committee to Address Commonality issues that exist between C Extensions for different embedded Systems. Historically embedded C Programming requires nonstandard extensions to C Language in order to support exotic features such as fixed -Point arithmetic multiple distinct memory banks and basic I/O operations.

### 2.2.3 Flash Magic

Flash Magic is a tool which is used to program hex code in EEPROM of microcontroller. It is freeware tool it only supports the microcontroller of Philips and NXP.

## III WORKING PRINCIPLE

The communication between airfield controller system and air craft module is done by zigbee transceiver are connected using UART. The GPS and zigbee transceiver connected to microcontroller with inbuilt UART. Whenever flight comes, first pilot sends the message to microcontroller via zigbee transceiver to check runway status it is free from fire, dust and obstacle for all the corresponding gas sensor, LDR sensor and IR sensor. Following longitude latitude of the landing zone which is displayed on the LCD. The microcontroller which initiates all these sensors and the GPS. Automatically arrester barrier will get on to prevent the entry for vehicles or human being, providing the runway for safe landing. Based on the received information from the ground station, the pilot will adjust the parameter of the airplane to hit that landing zone. Once if he reaches the landing zone the controller will respond a signal to the ground station. The pilot receives the data and drives the plane

according to it. The last data will send the above mentioned data along with data which indicates the beginning of the runway.

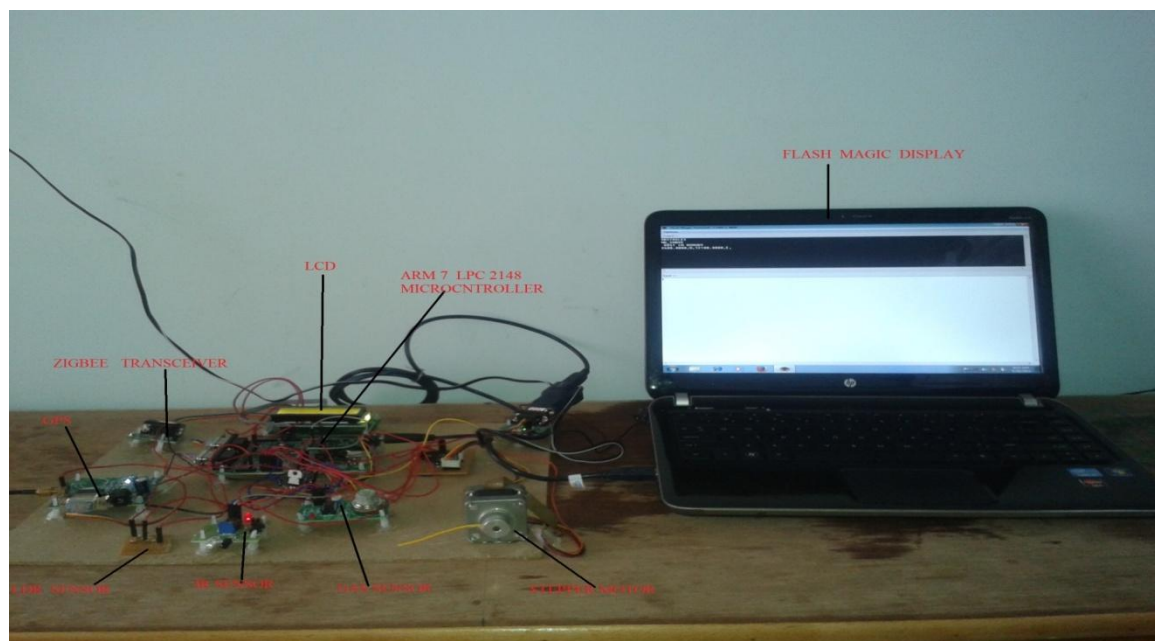


Figure.3.1 Project set up of Automated Airfield Controller System.

Once if the flight lands on the runway IR sensor in that runway senses the plane and sends a signal to the ground station controller. As soon as the ground station controller get the IR signal, it will immediately transmits a busy signal in the RF transceiver, so the other plane which is planning to land will get the busy signal and it will wait for the clearance signal. Once the landed plane crosses the runway IR sensor will sense the plane and it will send a signal to the microcontroller in the ground station. Once the signal is received immediately the controller will send a clearance signal to the other flight. if any obstacle, fire, dust found the runway the microcontroller will send the message to the pilot and the ground controller system will communicate with plane to take the necessary corrective action about the safe landing .

The final assembly of the project work done is shown in fig 3.1. The final model is interfaced with flash magic software. The system has been tested for variant relevant condition.

#### **IV. CONCLUSION**

It can be concluded that pilot can land the flight safely by using automated airfield controller system. The ARM7 LPC2148 controller which is the biggest advantages works with 32 bit data it send the data within a fraction of second and the pilot in airplane and commander in the ground station interact without any traffic. Zigbee transceiver which is fixer in both transmitter and receiver following this process will be going on quickly. The present attempt is to save aircraft from the unexpected problem such as fire accident, fog or snow. The ARM7 microcontroller is based on reduced instruction set computer principle and related decode mechanism are much simpler than those of micro programmed complex instruction set computer, can be used to check the runway status very quickly and takes protective measures until the flight completely stops in the Airport.

#### **V Acknowledgements**

I would like to acknowledge Mr.D.Suresh Chandan, Knowx Innovation (p) Ltd, for his constant help in carrying out this work.

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