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# Microcontroller Based Airport Signal Lamp Control and Monitoring

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**Abstract**

In this paper a proposed microcontroller based navigation-by-communication system for informing the pilot of an aircraft as to the location of the aircraft along the approach-landing path, and along the runway during the critical period of landing and during take-off, especially during conditions of light and/or weather which prevent outside visual reference to terrestrial or celestial fixes.
This light will visibly communicate the current risk level issued by the DHS by illuminating the appropriate corresponding color: green for low, blue for guarded, yellow for elevated, orange for high, and red for severe. Standard models are available with steady-on LED or incandescent light sources, which can be flashed through the use of a relay and microcontroller or PLC.

**Index Terms**: Microcontroller, Aircraft, Airport, Signal lamp, Control.

## 1. Introduction

The main objective of this paper presents is to monitoring the master signal light ON status signal for the aircraft to take-off. The master signal light is monitored by the control room on the ground station. The control room is having hardware interface of output lamp indicators from microcontroller controller based control and monitoring system.

The microcontroller receiving output from master lamp by using current transformer if output fails to receive from master lamp immediate alarm turn to ON, and the LCD display status of which lamp failure whenever the signal light is switched on the controller monitors the status are should be glowing. If the signal light not glowing or fused, the microcontroller drive the alarm circuit NO/NC contact with

Illumination switch is used to turn ON the signal light, so when the light fails the monitor bulb will toggle along with the buzzer indicating a failure. The buzzer can be reset using reset button.

**Table 1**

**Standardized Aircraft Lighting**

| Turn on | Rotating beacon | Navigation/Position lights | Strobe light* | Taxi lights | Logo lights | Landing lights |
|---|---|---|---|---|---|---|
| Engine(s) running | ● | | | | | |
| Taxiing | ● | ● | ● | ● | ● | |
| Crossing a runway | ● | ● | ● | ● | ● | ● |
| Entering departure runway for line up and wait | ● | ● | ● | ● | ● | |
| Takeoff | ● | ● | ● | ● | ● | ● |

* Strobe lights should not be illuminated if doing so will have an adverse effect on other aircraft or vehicles.

The microcontroller based system has to operate as per standard aircraft landing lamp system as shown in Table 1. This can be programmed using keil software tool in embedded C programming [1]

**Table 2**

| **Type of Signal** | **Meaning** | |
|---|---|---|
| | **Aircraft In Flight** | **Aircraft on Ground** |
| Steady Green Light | Cleared to land | Cleared for Take- Off |
| Steady Red Light | Give Way to other Aircraft and Continue circling. | STOP |
| Series of Flashing Green Lights | Return for a Landing | Cleared to Taxi |
| Series of Flashing Red Lights | Aerodrome Unsafe, DO NOT LAND | Taxi Clear of Landing Area in Use |
| Series of Flashing White Lights | Land at this Aerodrome and Proceed to the Apron | Return to Starting Point on the Aerodrome |
| Red Pyrotechnic Light or Red Flare | Do not Land for the time being. CANCELS any previous permission to land | |

Table 2 represents the aircraft visual and pyrotechnic signals. These aircraft traffic signal lamps are in red and green in colours. These colour lamps are steady or flashes for various meaning and indications

## 2. Architecture of Prposed System

The architecture of proposed system is consists of 8-bit microcontroller P89V51RD2, LCD interface module, relays, lamps and other necessary accessories as shown in Fig. 1.

### 2.1 Hardware

The hardware includes the Philips 8-bit microcontroller P89V51RD2, operational amplifier LM358, Lamps, Buzzer, Transformer for DC power supply through full wave rectifier, Master Lamp and Slave Lamps for indicators. The microcontroller is an incredible device and is similar to that of a computer. It has all the features of a microcomputer, to name a few it has a microprocessor, ROM, RAM, timers, built in UART etc. The microcontroller is that it can be programmed according to the algorithm developed to control and monitor the lamp signals using embedded C programming in Keil software tool [2].

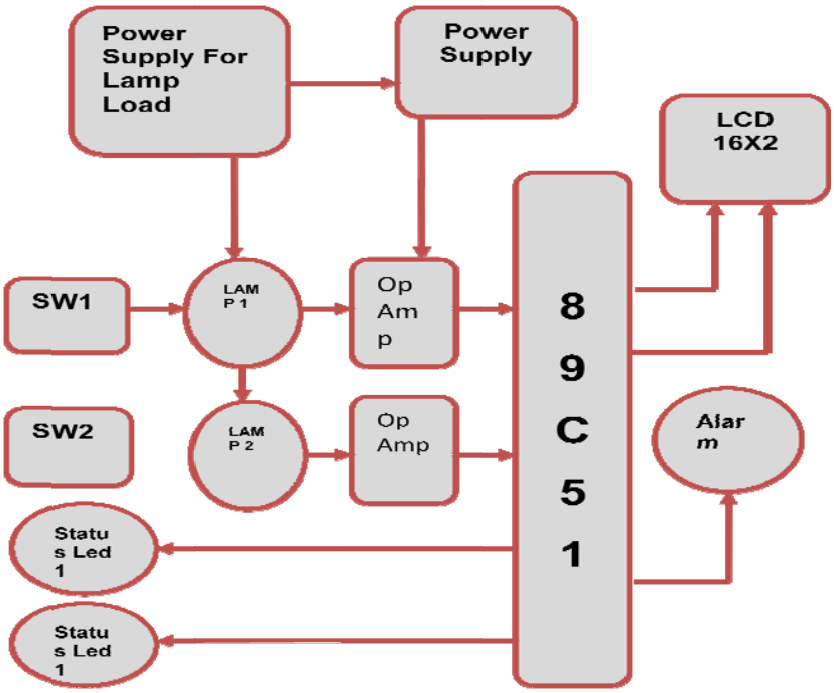


**Fig. 1**: Block diagram of proposed system.

### 2.2 80C51 Microcontroller

The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM. The key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency. The Flash program memory supports both parallel programming and in Serial In-System Programming (ISP).

Parallel programming mode offers gang-programming at high speed, and reducing programming costs. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible. The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running [7].

An operational amplifier has two inputs and one output. The circuit is designed so that the output voltage is proportional to the difference between the two input voltages [3]. Here we used LM358 operational amplifier. A relay is an electrically operated switch. Many relays use an electromagnet to operate a switching mechanism mechanically, but other operating principles are also used. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal. LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. The buzzer or beeper is a signaling device. It is connected to the control unit through the transistor that acts as an electronic switch for it. When the switch forms a closed path to the buzzer, it sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Incandescent bulbs can operate on either AC or DC power. if their voltage rating is high A separate power supply is given in the circuit

## 3. Programming Software

The keil provides with software development tools for the 8051 family of microcontrollers. Keil provides following tools for 8051 development such as C51 Optimizing C Cross Compiler, A51 Macro Assembler, Source-Level Debugger/ Simulator, µVision for Windows Integrated Development Environment [6].

### 3.1 Keil C cross compiler

Keil is a German based Software development company. It provides several development tools like, Integrated Development environment (IDE), Project Manager, Simulator, Debugger, C Cross Compiler, Cross Assembler, Locator/Linker.

## 4. Experimental Setup and Results

The experimental setup is tested is shown in Fig. 2 and verified by the operations shown in table 3. The experimental setup can works on autonomous standalone system with sequence of operations as per program developed for microcontroller in embedded C programming.

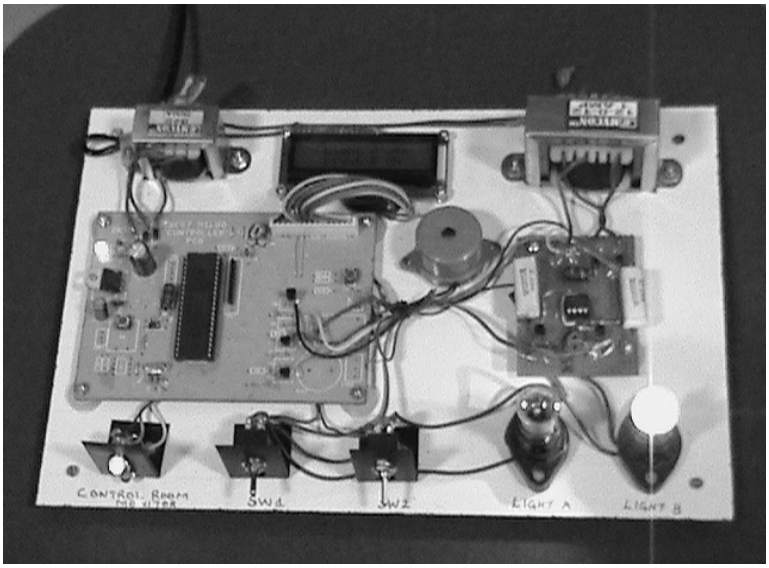


**Fig. 2**: Experimental Setup.

The practical results and lamp signal status are observed on the LCD display unit of experimental setup as shown in the table 3 which gives the experimental tested results for the successful operations.

**Table 3**

| Sl. No. | Switch Position | Control Room LED | Runway Light | LCD Display |
|---|---|---|---|---|
| 1 | SW1 OFF<br>SW2 OFF | GREEN‘OFF’<br>RED ‘OFF’ | LIGHT A ‘OFF’<br>LIGHT B ‘OFF’ | LIGHT A ‘OFF’<br>LIGHT B ‘OFF’ |
| 2 | SW1 ON | GREEN ‘ON’<br>RED ‘OFF’ | LIGHT A ‘ON’<br>LIGHT B ‘OFF’ | LIGHT A ‘ON’<br>LIGHT B ‘OFF’ |
| 3 | SW2 ON | GREEN ‘OFF’<br>RED ‘ON’ | LIGHT A ‘OFF’<br>LIGHT B ‘ON’ | LIGHT A ‘OFF’<br>LIGHT B ‘ON’ |

## 5. Conclusion

The experimental setup is a prototype only for conceptualizing the monitoring system. The microcontroller based Aircraft Take-off signaling system is the concept and implemented practical module and tested for successful operations. Further developing and scope for improvement using high-end technologies such as GSM, GPS, Internet etc., has been carried out.

# 6. Future Scope

## 6.1 Additional Innovative options

- Monitoring of various compliances related to safety, serviceability, driver behavior, etc.
- Emergency Services: crash reporting.
- Aircraft Tracking System is of the art GPS and GSM technology which enables to track and monitor any assets or aircraft using existing communication networks.
- Advanced Flight Visualization System
- Virtual Boundary / Fencing for wild animals in Forest & Agriculture
- Positioning information of vehicles can be obtained by using GPS technology.
- GPRS provides high speed wireless IP services for mobile users, fully supports the TCP/IP, wireless GPRS scheme can be taken to transmit data of mobile objects.
- Constructing an intelligent traffic monitoring system.

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