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Development of an Inbuilt UHF Signal and Weather Parameters Measuring System

Adewumi Adebayo Segun[1], Alade Michael Olusope[2], Adewumi Hope Kofoworola[3]
[1,2,3]*Department of Pure and Applied Physics Ladoke Akintola University of Technology*
Ogbomoso, Oyo State, Nigeria.

Abstract: ***This paper presents the development of an inbuilt measuring system suitable for measuring UHF signal strength and weather parameters concurrently for accurate prediction of the effects of weather parameters on UHF radio wave propagation at any location in time rather than using existing models developed from different climate entirely for analyzing data obtained in another climatic region. The sensitivity, resolution and the accuracy of the developed system will enhance the development of more accurate models which will provide UHF link planner a better platform for improving on their system designs and performances so as to provide a lasting solutions to signal degradation by weather parameters.***
Keywords: ***inbuilt, microcontroller, resolution, synchronization, prediction, accuracy.***

I. INTRODUCTION

This work was motivated by the desire to improve on the accuracy of the results obtained from experimental measurement of data for predicting the influence of weather parameters on radio wave propagation as observed by some researchers as in [4], [5], [2], [1] and [3] so as to reduce the likely error that may occur during synchronization of data obtained through different instrumentation systems or equipment. In some situations, many radio researchers measure signal strength variations at a particular location and synchronized it with weather parameters data obtained from meteorological station situated at far distances away from the experimental location for analysis and predictions not minding the possibility of changes or variation in weather parameters between the two different locations [6]. Sometimes synchronization of data from different sources also contributes greatly to some of the errors accumulated from analysis of such data particularly when the parameters are measured by different instrumentation systems of different sensitivities, resolutions and accuracy. Hence, it becomes necessary for instrumentation physicist and engineers to begin to think logically on how to develop multiple inbuilt systems centrally controlled by the same logic unit or processor for more accurate predictions and accurate development of models. In this work, a less costly inbuilt UHF signal strength and weather parameters measuring instrumentation system has been developed for storing variations in UHF radio wave signal strength concurrently with variations in atmospheric weather parameters at any location for accurate analysis and predictions of UHF signal impairment by atmospheric weather parameters so as to improve on system design and performance predictions which will enhance better transmission and reception of radio wave signals. Since it is less costly, radio researchers in the underdeveloped countries can easily make use of it for carrying out measurement rather than depending on existing models developed from different climatic region for analysis and predictions.

II. SYSTEM DESIGN DESCRIPTION

An overview of the whole circuit diagrams of the instrumentation system is presented in figure 1a and 1b. The system consists of two sub-sections namely; the exterior sub-system (usually placed outside for easy access to signal and weather parameters) and the interior sub-system (placed inside to receive and log the data measured from outside).

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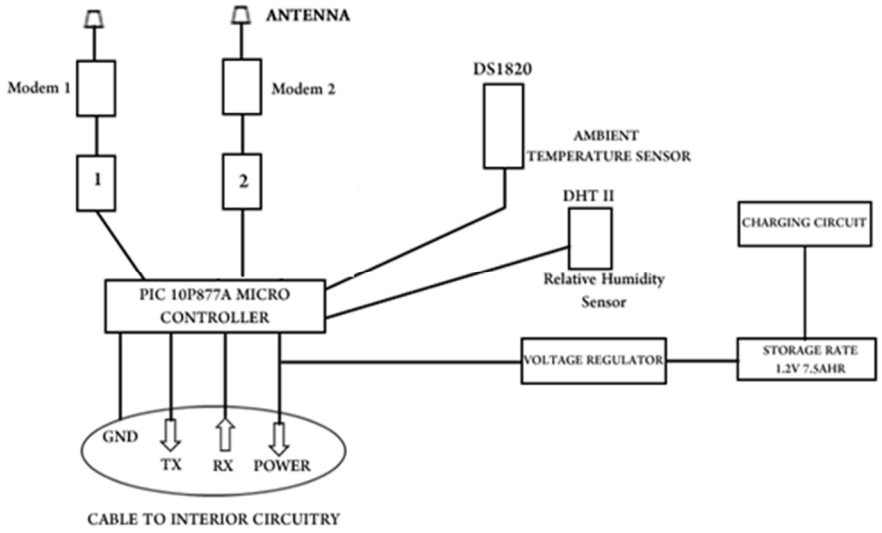

Figure 1a: Schematic circuit diagram of the external sub-system

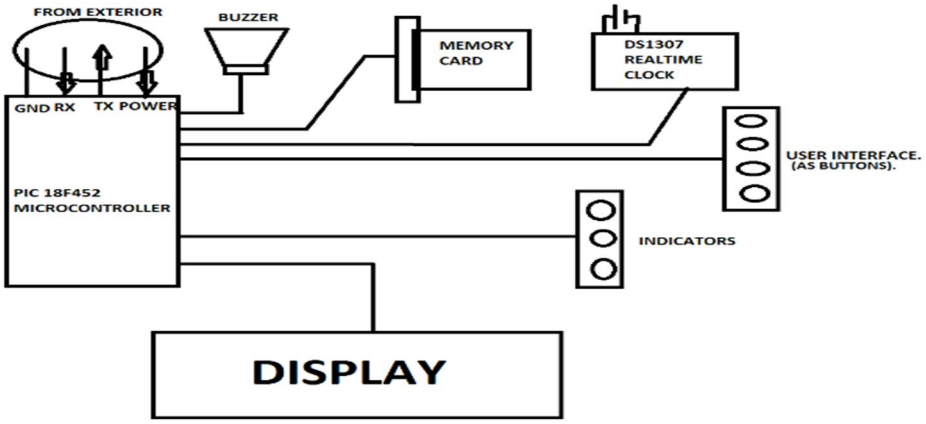

Figure1b: Schematic circuit diagram of the internal sub-system

III. THE SYSTEM MAJOR COMPONENTS FEATURES, SPECIFICATIONS AND DESCRIPTIONS

The exterior sub-system requires installation of a mobile receiving system which consists of Modem controller, DS18S20 High-Precision 1-Wire Digital Thermometer, DHT11 Relative Humidity sensor, sensitive receiving antennas, PIC 16F877A Microcontroller, 12v, 7.5AH storage battery, charging circuit, voltage regulators and RF transceiver. The antennas used were selected specifically to receive signals at the available GSM frequency. Different subscriber identification modules cards (SIMs) were fixed in the modem and each connected to the modem controller. The interior sub-system otherwise called data lodger (figure1b) consists of (64x8) DS1307/Serial Real Time Clock, HD44780U (LCD-II) Dot Matrix Liquid Crystal Display, User interface (as button), Indicators (Light Emitting Diode) and Memory Card, all connected to PIC 18F452 Microcontroller.

IV. THE MODEM CONTROLLER

The modem controller is a silicon chip which is specialized in the modem control using AT commands. It simplifies the interconnection of GSM modems in controller and microprocessor environment. Power supply voltage (+5.0V), speed, and power consumption are features of this family. It is fabricated using advanced CMOS to realize high speed control and low power consumption. The interface of the modem is a standard RS232 interface with a baud rate of 9600bps with ability to control each

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modem by calling for the signal data received by each of them before collation and transmission to the PIC 16F877A Microcontroller.

V. THE PIC 16F877A MICROCONTROLLER

PIC16F877A Microcontroller device is available in 40and 44pin packages with five I/O ports, fifteen interrupts and eight A/D input channels. It operates at a DC frequency of 20MHz with data memory of 368bytes and EEPROM Data of memory of 256bytes. PIC16F877A has the capacity of operating on 35 instructions set using MSSP or USART and PSP serial parallel communications. The block diagram is shown in figure 2

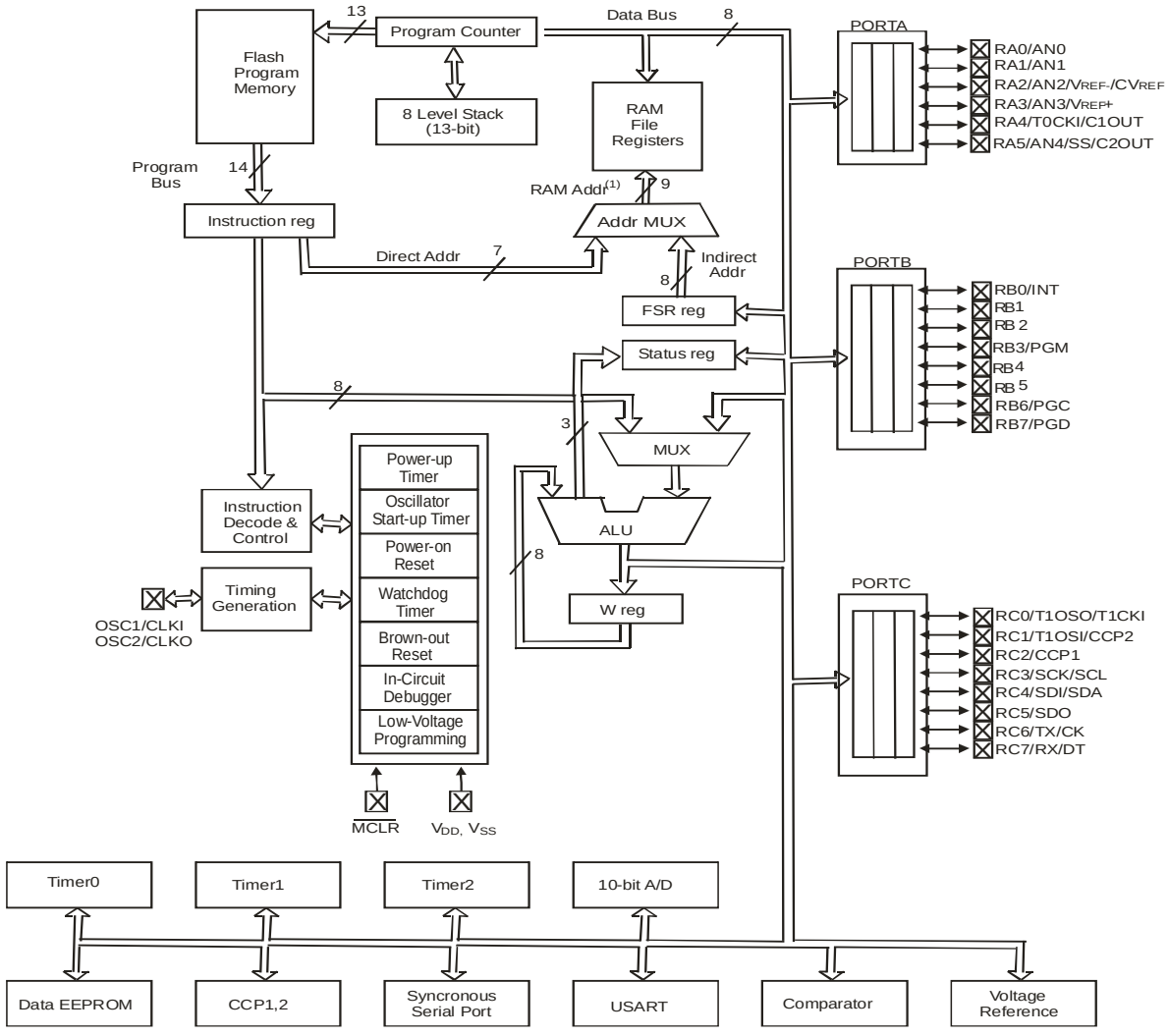

Figure2: Block diagram of PIC16F877A Microcontroller. Source: (http:// www.microchip.com.)

VI. THE PIC 18F452 MICROCONTROLLER

PIC 18F452Microcontroller device is available in 40/44-pin packages. It operates at a DC frequency of 48MHz with a program memory of 3276bytes and data memory of 2048bytes. It has five I/O ports and operates on MSSP or enhanced USART. It can work on 75 instructions. This microcontroller incorporates a range of features that can significantly reduce power consumption during operations.

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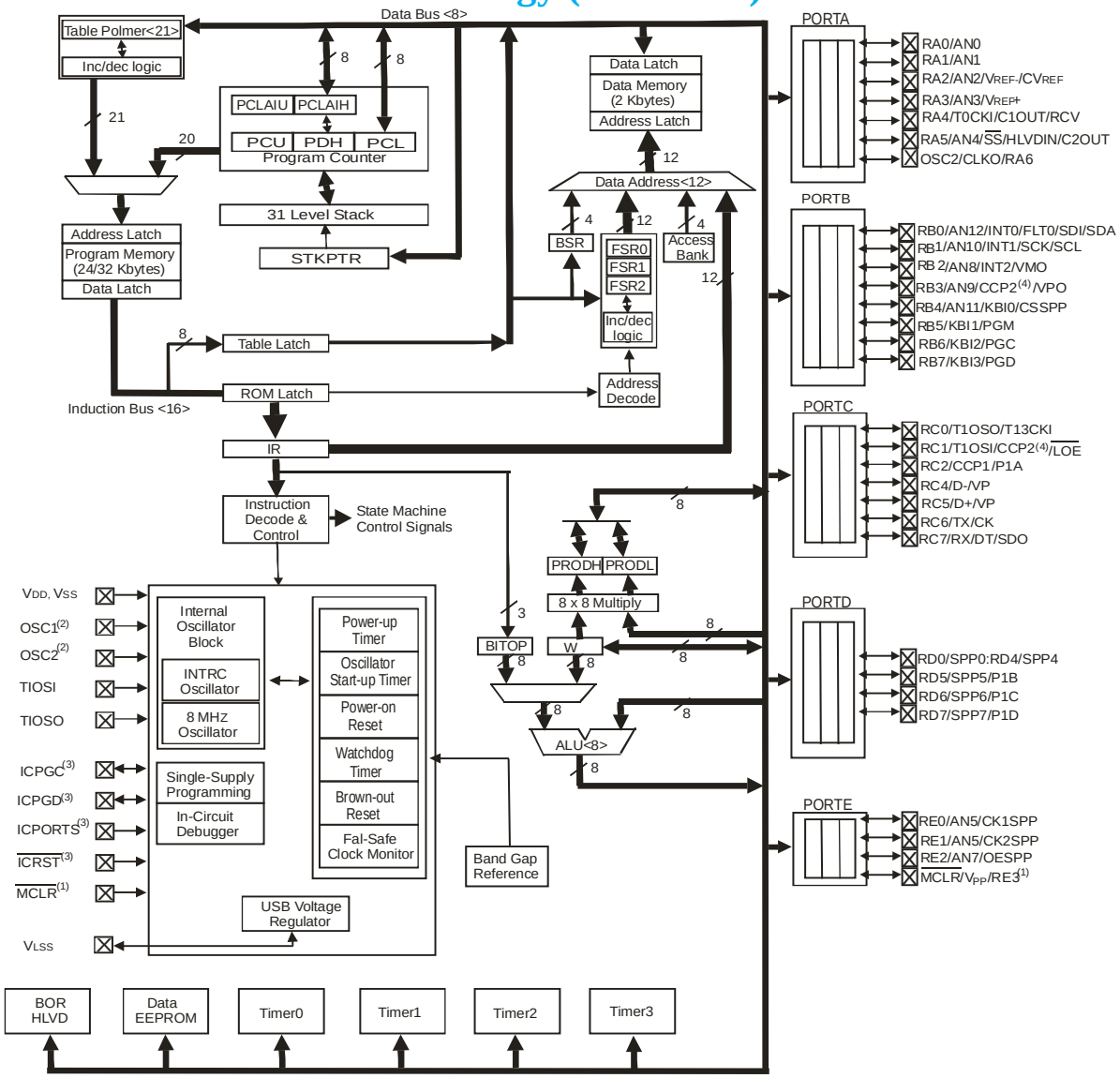

Figure 3: Block diagram of PIC 18F452 Microcontroller. Source: (http:// www.microchip.com.)

VII. WORKING PRINCIPLE

The operation (working principles) of the constructed modules is in three phases/stages:

The Internal module/unit

Time Setting Routine

External module/unit operation

The flowcharts in figure 4, figure 5 and figure 6 show detail operations of each of the modules

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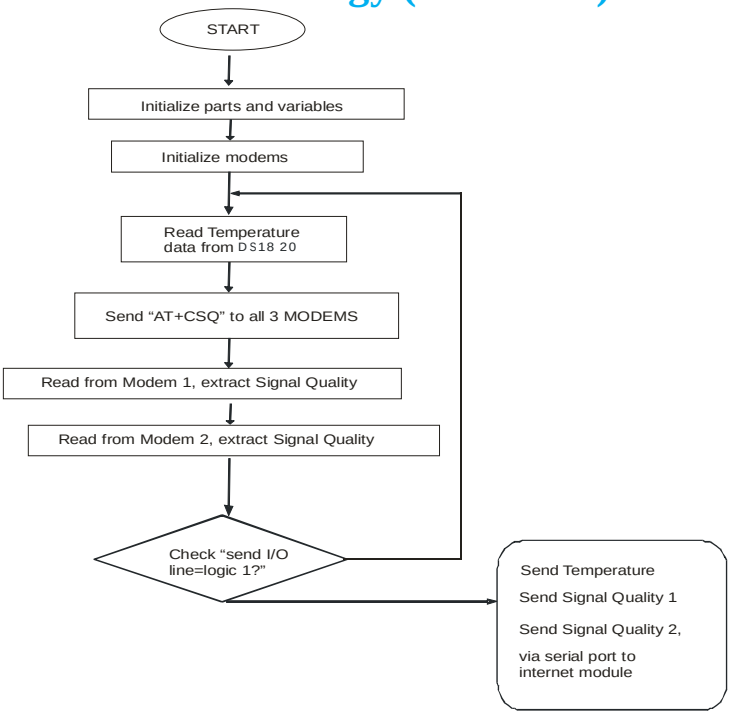
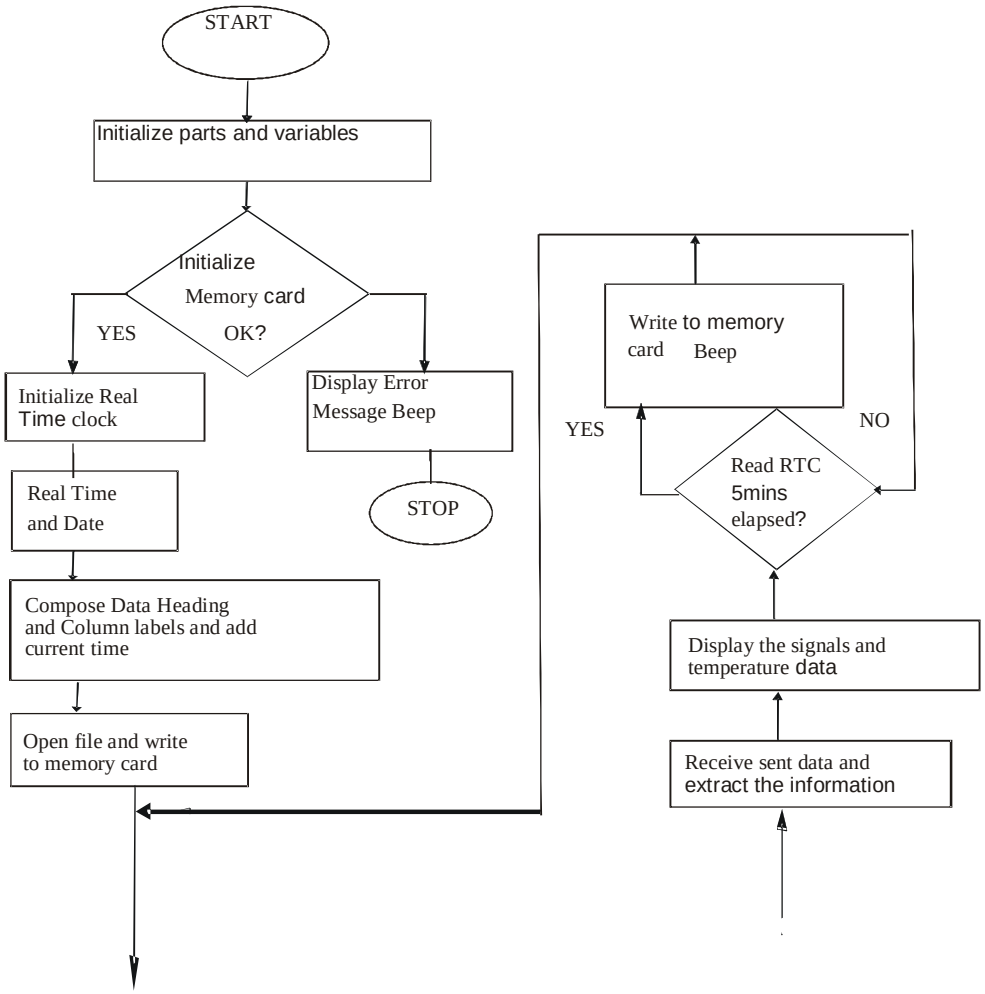


Figure 4: External sub-system operation flow chart



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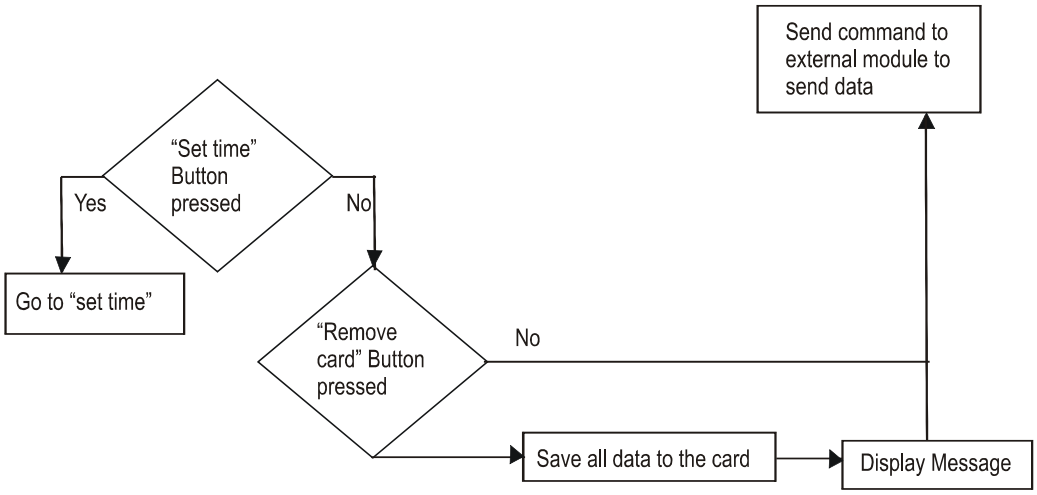
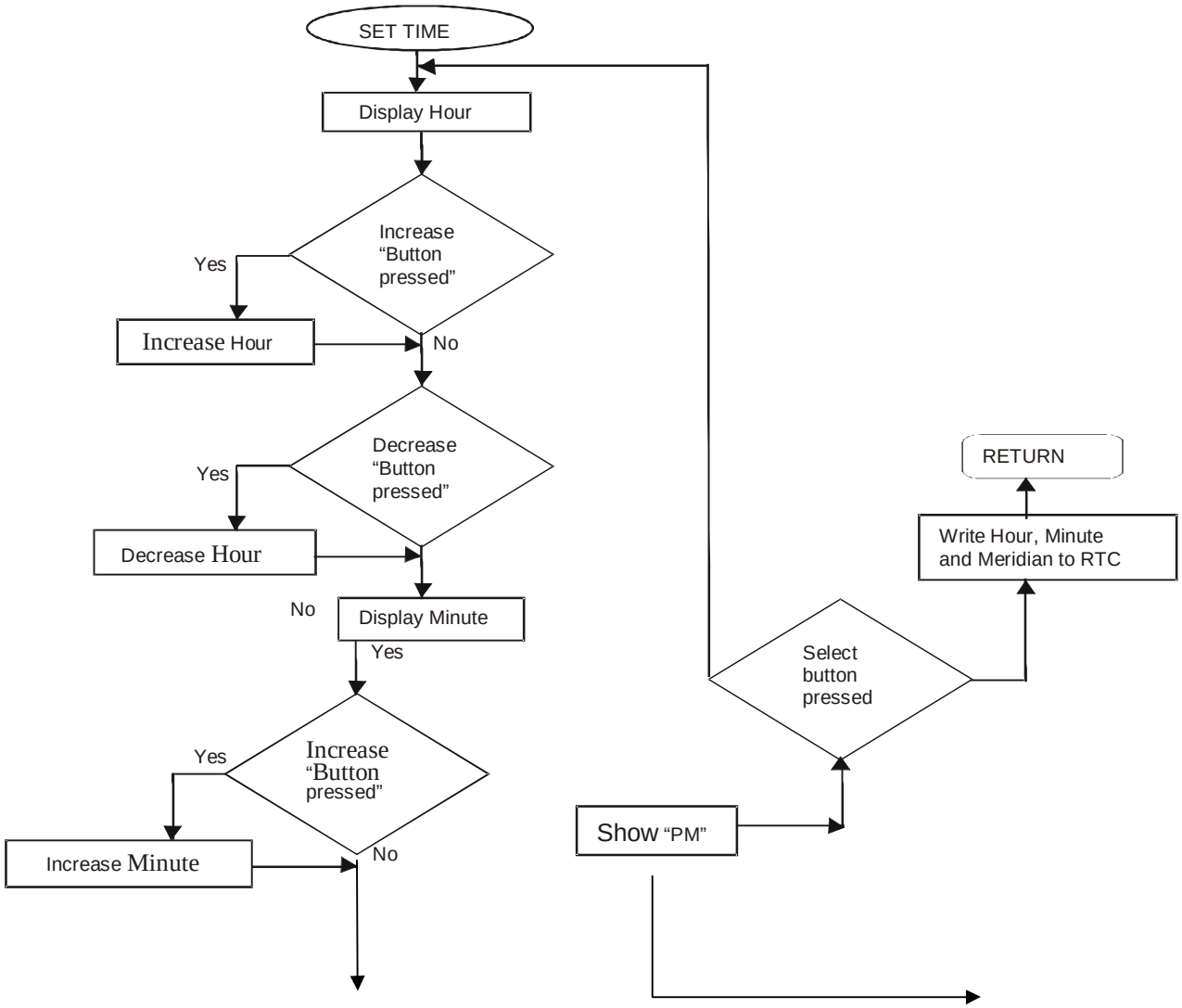


Figure5: Internal sub-system operation flow chart



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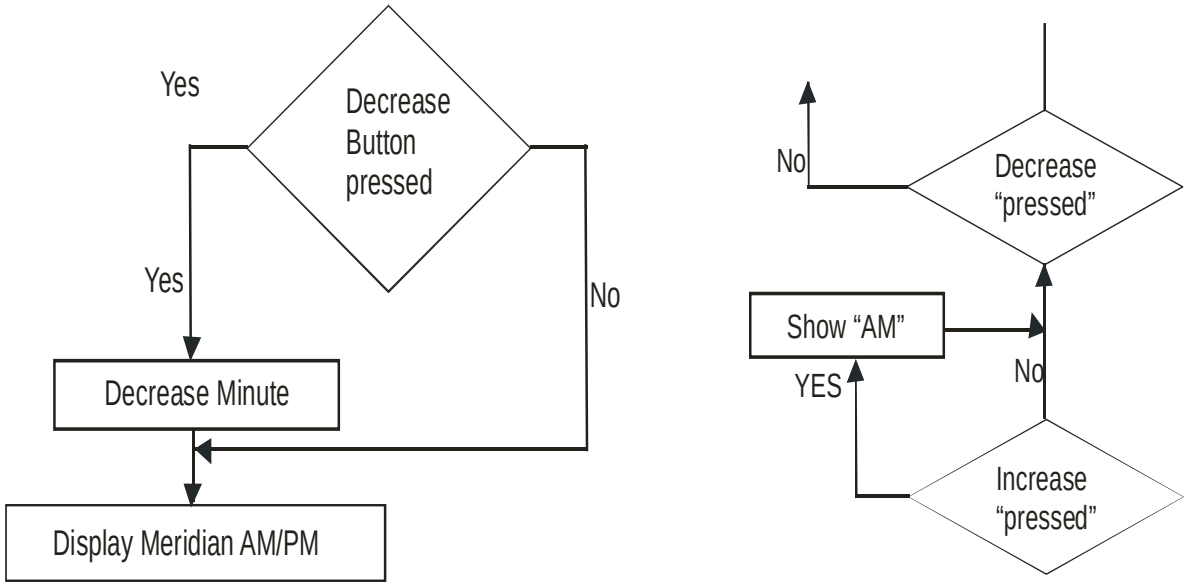

Figure 6: Time setting routing flow chart

VIII. REMARKS

Visual basic program compiler was used to implement the flow chart on the instrumentation system after construction

IX. CONSTRUCTION STAGE:

The various electrical components were coupled and assembled as shown in figure 7, figure 8, figure 9 and figure 10

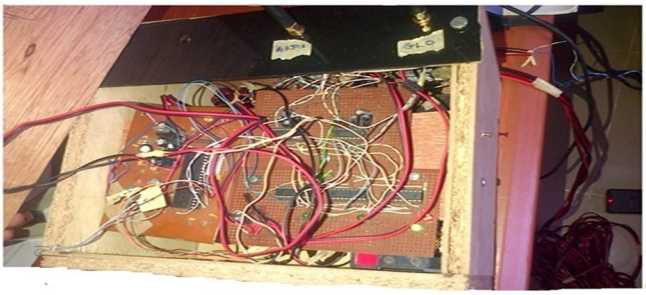

Figure 7: components of the external circuitry

Figure 8: Implementation state of the exterior subsystem

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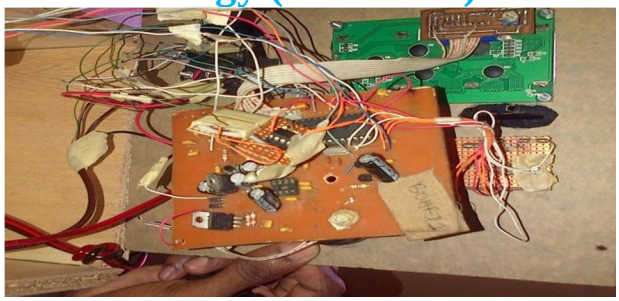


Figure 9: Installation of the Interior sub-system components

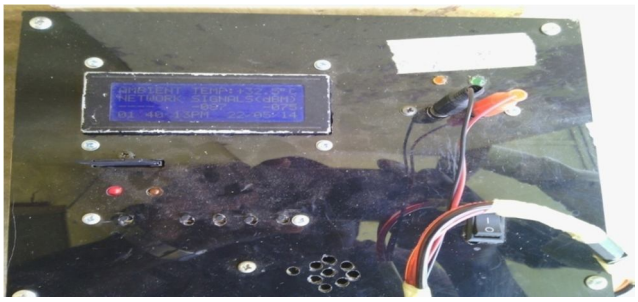
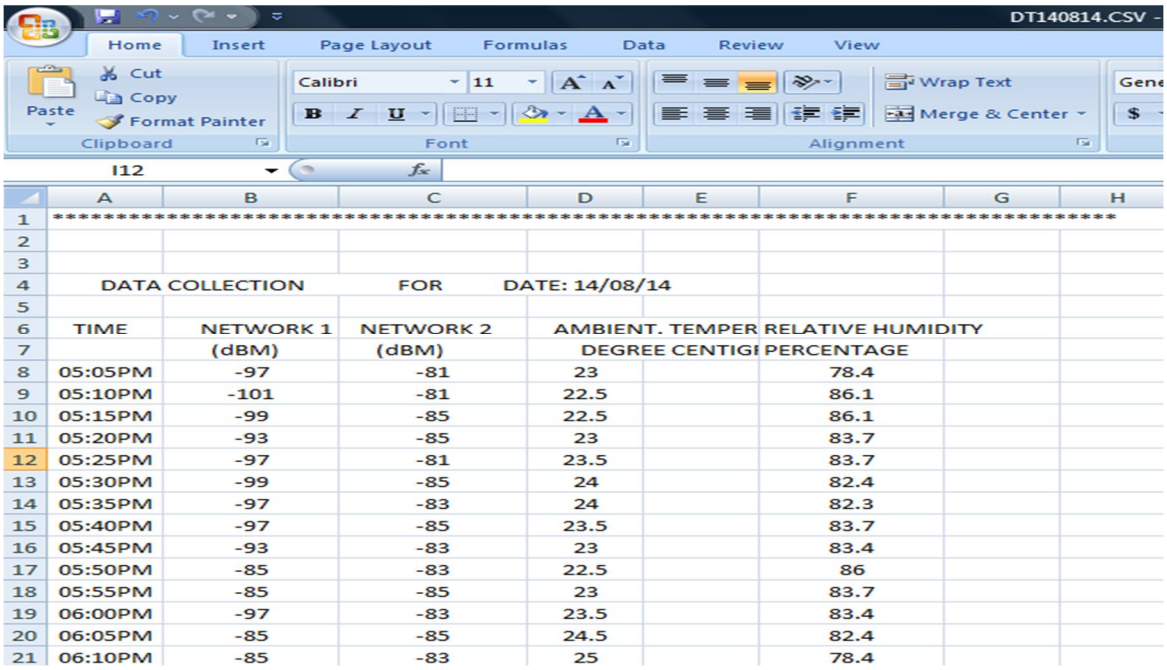


Figure10: Implementation state of the interior subsystem

X. OVERVIEW OF THE LOGGING PATTERN



	A	B	C	D	E	F	G	H
1	**********							
2								
3								
4	DATA COLLECTION		FOR	DATE: 14/08/14				
5								
6	TIME	NETWORK 1	NETWORK 2	AMBIENT. TEMPER		RELATIVE HUMIDITY		
7		(dBM)	(dBM)	DEGREE CENTIGI		PERCENTAGE		
8	05:05PM	-97	-81	23		78.4		
9	05:10PM	-101	-81	22.5		86.1		
10	05:15PM	-99	-85	22.5		86.1		
11	05:20PM	-93	-85	23		83.7		
12	05:25PM	-97	-81	23.5		83.7		
13	05:30PM	-99	-85	24		82.4		
14	05:35PM	-97	-83	24		82.3		
15	05:40PM	-97	-85	23.5		83.7		
16	05:45PM	-93	-83	23		83.4		
17	05:50PM	-85	-83	22.5		86		
18	05:55PM	-85	-85	23		83.7		
19	06:00PM	-97	-83	23.5		83.4		
20	06:05PM	-85	-85	24.5		82.4		
21	06:10PM	-85	-83	25		78.4		

XI. CONCLUSION

The developed inbuilt instrumentation system has been built to minimize errors and inaccuracy that usually occur during experimental investigations of the effects of weather parameters on UHF radio wave propagations due to the use different measuring equipment of different resolutions and accuracies and as well as synchronization of data obtained from relatively short distances of variable weather parameters. This instrumentation system will enhance accurate predictions of the influence of weather parameters

on UHF radio wave propagation and help do developed accurate model from the measured data at any location in time.

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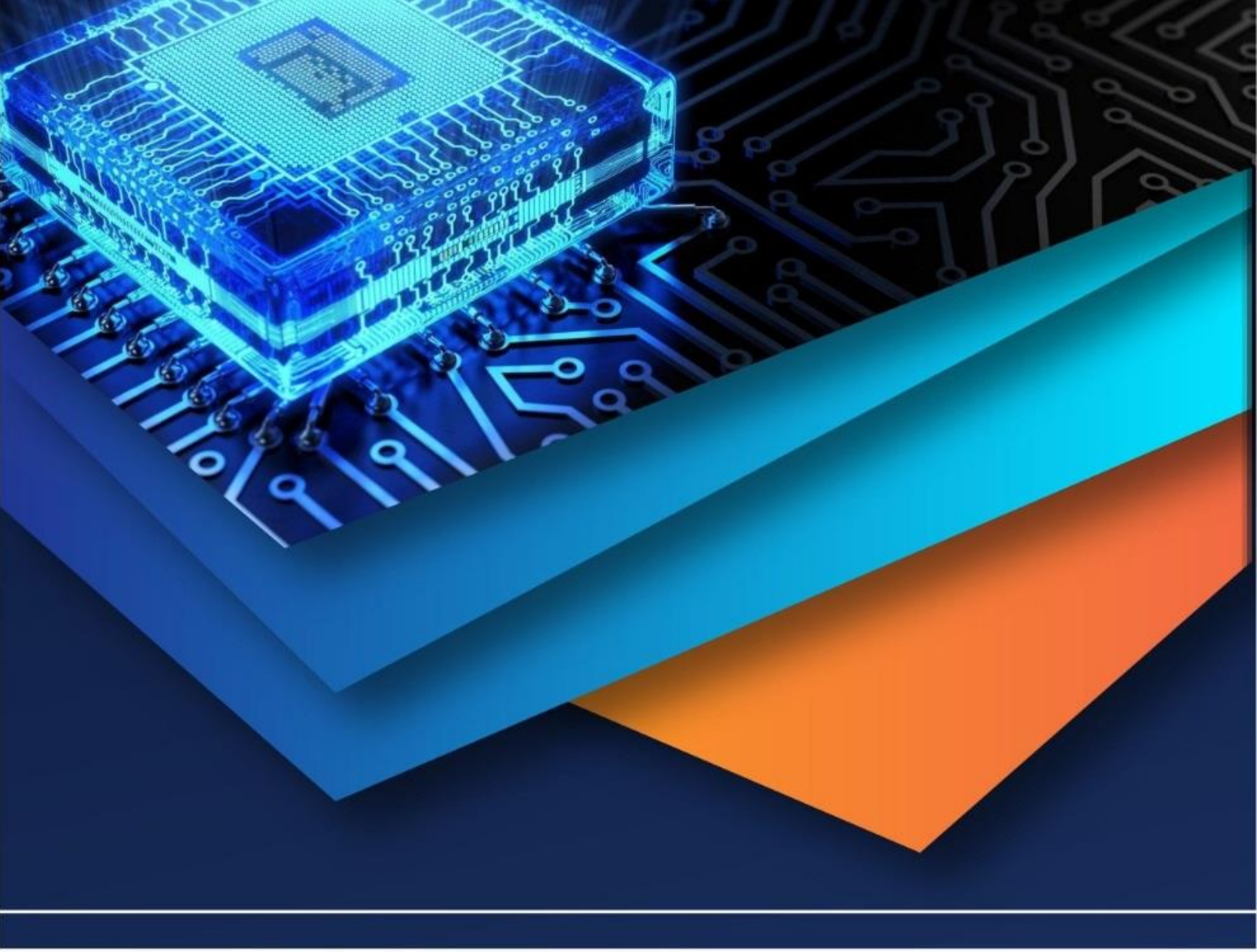

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