AUTOMATIC ALIGNMENT OF MICROWAVE DISH ANTENNAS

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ABSTRACT

Project focuses on the solution of Microwave (MW) link alignment. Alignment is done manually by riggers by climbing up to towers of as high as 90 meters. It is very much dangerous and cumbersome. Assuring the automated alignment of antennas provides a better communication between Base transceiver stations and allows soft handover that ultimately allows its subscribers to communicate ceaselessly .Automatic alignment of microwave dish antennas will reduce the downtime which will be very helpful to telecom industry. MW antenna used in communication systems is regularly affected by environmental factors generally due to the strong wind, earthquake or some other natural disasters. Automatic alignment will provides us reliable communication between two points at large distance.

Microwave communication is used for point to point links with small wavelength and simultaneously compact antenna dimensions. In the first part of the work; effects of downtime on a network are discussed and at later stage a mechanism is investigated which will reduce the downtime.

Automatic alignment of microwave dish antennas can be done in two directions, vertical and horizontal. For this purpose we have made a structure having two motors used for vertical and horizontal alignment.

These motors are made to operate with the help of h-bridge circuits, which are getting instructions from microcontroller. During operation horizontal alignment is done in first place to provide plane for movement and vertical alignment in second place.

Full operation is feed into decision making device which in this case is microcontroller, the decision making device send instructions to h-bridge circuits to move motors in the desire directions.

CERTIFICATE

It is certified that the work contained in this thesis entitled **"Automatic Alignment of Microwave Dish Anteen" was** carried out by Capt Muhammad Junaid, Capt Yasir Mehmood and Capt Ali Javed under the supervision of Lt Col Dr Abdul Rauf for the partial fulfillment of degree of Bachelors of Telecommunication (Electrical) Engineering is correct and approved.

Approved by

____

(Lt Col. Dr. Abdul Rauf)
Project Supervisor
Military College of Signals (MCS)

Dated: _____ June 2015

DECLARATION

No portion of work presented in this dissertation has been submitted in support of another award or qualification either at this institution or elsewhere.

DEDICATION

To our Parents and Teachers, without whose support and cooperation, this project would not have been possible.

ACKNOWLEDGEMENTS

First of all, we praise Allah Almighty, who gave us strength to undertake this project and to complete it in a timely and efficient manner.

We wish to express our gratitude to our supervisor Lt Col. Dr. Abdul Rauf from Faculty of Electrical engineering department, Military College of Signals, National University of Sciences and Technology, for his continuous support and supervision during the course of the project. His persistent guidance is certainly commendable.

Special thanks to Assistant Professor Zeeshan Zahid from Faculty of Electrical Engineering, Military College of Signals, NUST, who helped us in the field of Microwave Antennas and we received enough guidance through his practical experience.

We would also like to acknowledge the struggle of our parents for our well-being and education. They have done enormous and endless efforts to make us standout. We would designate our success to them.

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List of Abbreviations

BTS	Base Transceiver Station
MW	Microwave
RSL	Received Signal level
IC	Integrated circuit
MC	Microcontroller
LOS	Line of Sight
DMM	digital multimeter
IDU	In-door unit
ODU	out-door unit
QoS	Quality of service
MS	Mobile station

1. PROJECT DESCRIPTION

1.0. OVERVIEW

Establishing a MW link and operating it for optimal performance has been pivotal in the present day world because of its enormous industrial applications. Keeping this in mind and to overcome the challenges posed by industrial application, an automated antenna alignment that works without human intervention has been the focus of research.

Concept of wireless communication has been originated by Alexander Graham Bell in 1880 when he did experimentations on modulated light and parabolic reflectors. Guglielmo Marconi made significant advances in origination of a telephonic system that works on electromagnetic wave pattern by investigating lower frequencies usually in the range of Hertz. This was furthered by him in 1895 by making a transmission of three dot Morse code possible for the letter 'S' over a distance of three kilometers [1, 2]. Advancements in transmission principles and network architecture have been very significant in the last couple of decades which has seen emergence of M2M networks. Conventional Man-to-Man network of GSM was improved to higher data rates by means of Man-to-Machine Networks and then finally Machine-to-Machine Networks that include 4G and LTE systems [3, 4, 5]. This has been possible gradually by increasing the data rates over the network and focusing on Quality of Service (QoS). Another big difference that has played its role has been transceivers; major industrial vendors such as Ericsson, NSN, NEC etc. have channeled their R&D towards making telecommunication systems and transceivers as efficient as possible while giving maximum range and keeping the cost of system as low as possible. Even with lot of research focused on telecommunications, there is still room for improvements and new innovations. This has prompted the need to use of Automation Control in MW alignment and other wireless systems.

1.1. PROBLEM STATEMENT

Antenna Alignment is the fundamental principle for all MW and generally wireless links and simultaneously a lot of research and development is in place to further the technology. The process is very sophisticated in nature due the usage of numerous resources ranging from test equipment's and processing units to Antenna hardware and ground technicians to engineers [6, 7]. In the existing technology, a collaborative effort that consists of tower technicians as well as Base Station engineers is required to ensure MW alignment. The process of link alignment is quite dangerous and hazardous as it is done at the antenna often as high as 90 meters from the ground. Tower crews also known as Riggers are responsible for establishing MW alignment on both ends of the transceivers by means of test equipment's that take into account the Received Signal Level (RSL). A signal is generated from the transmitting end through In-door unit; here the transmitting power is set before converging the signal to IF physical channel. IF channel serves as the interface between In-door units placed on the ground and Out-door unit which is typically an Antenna or a Radio Device. The signal is then transmitted through the RF source over the free space link. On the far end, a transceiver receives the signal intended for it and it is of the same frequency range that was initially set at the transmitting end. This sets up the basic interconnection between the two stations. The RSL at the receiver end can be measured manually by the rigger at the antenna by means of Digital Multi-Meter (DMM) or through the software package installed on the In-door unit. Existing mannerism in which MW alignment is carried out is quite cumbersome. There are number of steps that have to be followed to ensure a proper link alignment. It has to be made sure that both near end and far end terminals have identical polarization and have same frequency band. The alignment is generally done on each end through continuous communication but it cannot be done simultaneously at similar instant of time. If a rigger starts on Near End Antenna; the antenna crew at Far End will hold and vice versa. Moreover on the near end; 2D approach is required in which firstly Azimuth (Horizontal Axis) is adjusted until the best RSL is achieved before starting Vertical Tilt and later the far end technician is informed to do the same process. The whole process is repeated couple of time to get the RSL as high as possible [6,8].

The quality of signal which is received depends upon the optimal direction of the two stations. If the two antennas are directional and are pointed optimally towards each other, highest signal concentration will be received through the main lobe and there will be minimal attenuation and degradation [1, 6]. Figure 1.1 depicts the scenario where MW link is optimally aligned and the main lobes are facing directly towards the intended antenna. On the other hand, if the main lobe is deviated from the receiver end, the link will be intermittent and have High Bit Error Rate (HBER).

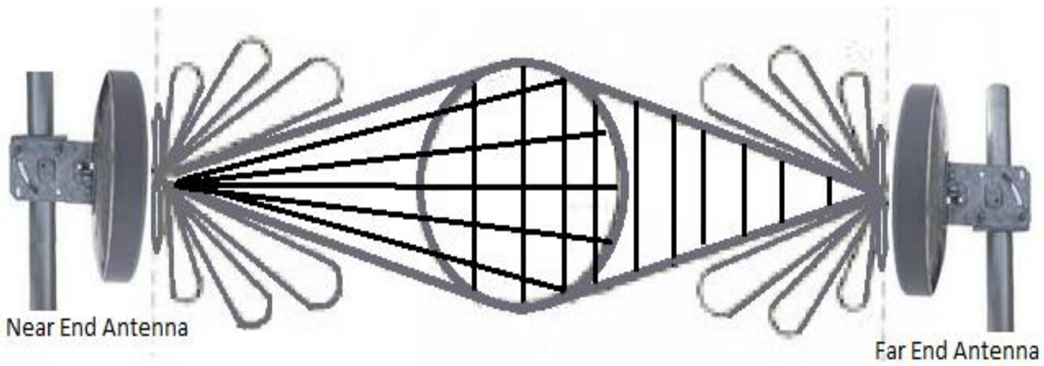


Figure 1.1 MW link between Near & Far End Antenna with main lobe and side lobes

To address the issue of communication problems due to the misalignment of antennas due to various reasons, we intend to design such a mechanism which would align the antennas automatically without any human intervention. A great deal of research has been propelled into the use of automated systems for the alignment of antennas to realize better and efficient communication systems.

1.2. APPROACH

The main purpose of this project is to investigate on methods and techniques to improve MW link alignment that is being done conventionally. A system that can work on stand-alone basis and needs no human intervention. Another significant aspect that has to be considered is to recover link in Time Optimal Manner so that downtime is kept as low as possible. This project deals with Wireless principles and interference avoidance of MW links as well as automation control. Antenna is to be perturbed so that it ensures best suited position for main lobe to be directed at the far end. A modeled solution is to be design and implemented. The objective is to design an automated MW alignment system in which a transceiver receives a certain RSL at Far End station. A closed loop system makes the basis of Logic for Microprocessor. If the received RSL is in this range, it will consider the antennas to be in their appropriate directions else alignment will start.

Considering due to weather conditions or other factors affecting the alignment, Far End Antenna receives a lower RSL; in this case an automated system will realign the link until the desired RSL is achieved. This alignment will be on horizontal and vertical axis of the antenna. It is to be noted that antennas are only perturbed from their intended positions because of environmental conditions or wear and tear. Keeping this in mind, the pattern to be devised is such that the alignment should be done within certain arc e.g. ± 45 degree in vertical tilt from starting point and a similar pattern in azimuth. The whole idea is to get Signal to Noise Ratio (SNR) as high as possible by optimally directed antennas. Besides this, it is to be investigated that the interference is avoided and that Signal to Interference Ratio (SIR) is also high. A secondary antenna that is responsible for interference has a main lobe and side lobes as well. Interference can be greatly reduced by antenna positioning through automation such that the space between main lobe and side lobe of interference source is benefited from.

2. SCOPE, SPECIFICATIONS AND DELIVERABLES OF THE PROJECT:

2.1. SCOPE:

The new technological era has improved the living standards and brought a major change to living styles. The world has become a global village; transmission of information from one place to another is extremely easy today. MW technology is of great importance in this regard. It can be used for the security purposes as well. Cell phone industry is emerging day by day due to microwave technology. Following are the main reasons for the emergence of Microwave technology:-

- It has a large bandwidth i.e. it can transfer huge information data from one terminal to other.
- Line of sight is required; no wires are involved between two switching stations.
- Antenna’s sizes are reduced day by day along with the increase in efficiency.
- It can accommodate large number of channels.

- Less power requirements.
- Economical.

2.2. SPECIFICATIONS:

All work shall be done on the microcontroller board. The choice of programming language for the coding of the device is C language.

Other primary resources required will be:

- Microcontroller circuits
- H-bridge circuits
- Dish antenna
- Motors

The project would require special skills in the following:

- C coding
- Proteous

2.3. DELIVERABLES OF THE PROJECT:

The deliverable of the project would be a device that would automatically detect the received signal level (RSL) and compare it against a threshold voltage value fed into the microcontroller. If the RSL falls below that level the antennas would be instructed so as to align themselves to achieve the desired signal level.

3. LITERATURE REVIEW

This section states the background study, motivation and need of the product developed as a result of this research. The detailed objectives and the thesis outline are also presented to give an overview of the project.

3.1 Microwave Link

Generally a microwave link means a beam of radio wave in microwave frequency range enabling a transmitter and receiver to communicate. Different forms of microwave link applications are available in modern communication system. Broadcasters use microwave links to send programs from the studio to the transmitter location, which might be miles away. Microwave link is the backbone in latest telecommunication system which makes our life easier. Wireless Internet service is another development where service provider can give facility of internet service without any cable. Most of the telecommunication companies communicate between their switching centers through this link although recently it is done by fiber optic cables as well. Many government and private organization use this technology to link up their corporate offices for easy and fast access to the main server. One of the reasons for the adaptability of microwave links is because they are broadband; meaning they can transfer large amount of information at high speeds. Another important quality of microwave links is that they require no equipment or facilities between the two terminal points. Often a repeater station is installed if the clear LOS in not available to maintain the signal in required RSL level. Installing a microwave link is often faster and less costly than a wired connection. Finally, they can be used anywhere as long as the distance to be spanned is within the operating range of the equipment and there is clear path between the locations [9]. Microwave link is seldom interrupted by rain, fog, and snow; though in harsh weather conditions, it can be disrupted at some instants.

Figure 3.1 Line of Sight

3.2 Need for Microwave

MW technology is of great importance. The world is now becoming a global village and everyone in this world has to communicate with the others in order to live happy safe and prosper life. Microwave technology can be used for the security purposes. Cell phone industry is emerging day by day due to microwave technology. Following are the main reasons for the emergence of Microwave technology:-

- It has a large bandwidth i.e. it can transfer huge information data from one terminal to other.
- Line of sight is required, no wires are involve between two switching stations.
- Antenna's sizes are reduced day by day along with the increase in efficiency.
- It can accommodate large number of channels.
- Less power requirements.
- Economical.

3.3 Line of Sight Consideration

Microwave radio communication requires a clear line-of-sight (LOS) [10] condition. Under normal atmospheric conditions, the radio horizon is around 30 percent beyond the optical horizon. Radio LOS takes into account the concept of Fresnel ellipsoids and their clearance criteria. Fresnel Zone - Areas of constructive and destructive interference created when electromagnetic wave propagation in free space is reflected (multipath) or diffracted as the wave intersects obstacles. Fresnel zones are specified employing ordinal numbers that correspond to the number of half wavelength multiples that represent the difference in radio wave propagation path from the direct path. Figure 3.2 shows a Line of Sight (LOS) where one microwave antenna has a direct link to another antenna placed at far end.

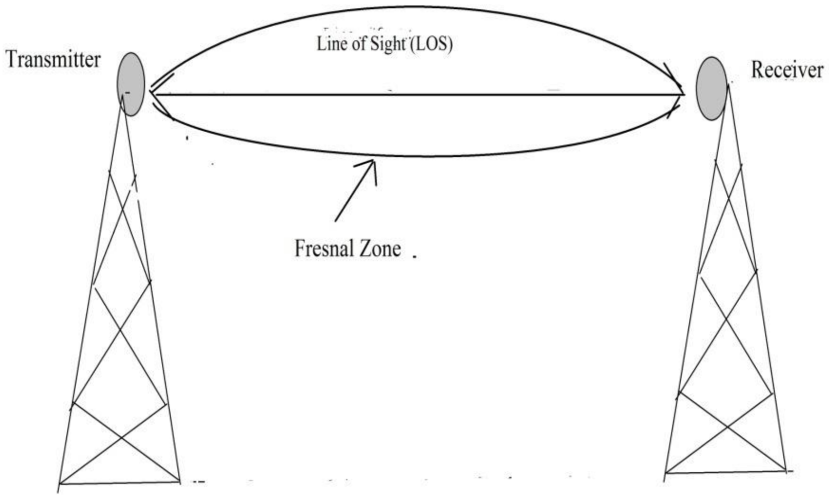


Figure 3.2 A typical Line of Sight (LOS) of a MW link

The Fresnel Zone must be clear of all obstructions. Typically the first Fresnel zone (N=1) is used to determine obstruction loss. The direct path between the transmitter and the receiver needs a clearance above ground of at least 60% of the radius of the first Fresnel zone to achieve free space propagation conditions [11].

Earth-radius factor k compensates the refraction in the atmosphere. Clearance is described as any criterion to ensure sufficient antenna heights so that, in the worst case of refraction (for which k is minimum) the receiver antenna is not placed in the diffraction region.

Clearance criteria to be satisfied under normal propagation conditions

- Clearance of 60% or greater at the minimum k suggested for the certain path
- Clearance of 100% or greater at k=4/3
- In case of space diversity, the antenna can have a 60% clearance at k=4/3 plus allowance for tree growth, buildings (usually 3 meter)

3.4 FSL (Free Space Loss)

Travelling from one antenna and approaching another antenna involves free space between transmitter and receiver. The signal gets weaker and fades away as it travels more and more distance. This phenomenon is called Free Space Loss (FSL). FSL is calculated while doing link budget analysis and it doesn't involve antenna transmitting power, antenna gains. These factors are normally addressed when designing a link budget and are used within radio and wireless survey tools [2, 10].

3.5 Effective height of antenna

Effective height of the antenna is a parameter to define the center of radiation Pattern of antenna above the effective ground level and it can be determined with the help of following expression [12].

$$h = \frac{2\pi nACos\emptyset}{2\ \lambda}$$

Where, n is number of turns.

A is the area of Loop Antenna and it is the angle of transmitter with Loop Plane and it is 0º λ is the wavelength

The number of turns "n" determines the size of loop antenna and the loop size alongside a capacitor used can tune a particular frequency.

Thus by inserting the values we get effective height of the antenna .Now the effective ground level is considered as the base of Circuit board and the center of radiation indicating the effective height of antenna shown in Figure given below.

It is theoretically measured to be 8.1mm. It can be seen that the effective height is bit on the lower side and this can be improved by increasing the number of turns in the loop antenna from 8 to 100 or more.

3.6 Alignment Technique

When Microwave dish antenna is misaligned it is first reported at OMC and then authorities called to riggers. Riggers reached at the site and climb up the tower of on average 90 meters high along with the test equipment. He continuously move dish and check signal strength on the test equipment. A signal is generated from the transmitting end through IDU .The transmitting power is set before converging the signal to IF physical channel. IF channel serves as the interface between In-door units placed on the ground and Out-door unit which is typically an Antenna or a Radio Device. The signal is then transmitted through the RF source over the free space link. On the far end, a transceiver receives the signal intended for it and it is of the same Frequency range that was initially set at the transmitting end. This sets up the basic Interconnection between the two stations. The system which had to be designed needed to do azimuth (horizontal axis) as well as vertical movement in such a manner that a single antenna is aligned. Prototyping for diversity and MIMO antennas have not been done but it similar in design however needs additional resources. In this project horizontal shift and vertical shift have been built independently and then integrated together

4. AUTOMATION CONTROL

There are two major disciplines in which this report is carried out. The first part is setting up a model of MW antenna, the second section deals with Automation Control. Now consider that a problematic link is reported in OMC and a solution is required to get it fixed as soon as possible and ideally without human intervention. This could be done by means of Motors, Microcontrollers, Gears, and closed loop feedback systems. The mechanism that has been approached in building up the automation system in our model consists of antenna model and control circuit. These standalone units are interfaced at the later stage to get the system running. It is to be noted that the microcontroller is programmed and then interfaced with h-bridge circuit by electrical and mechanical means. A descriptive sequence of processes is described in the flow chart.

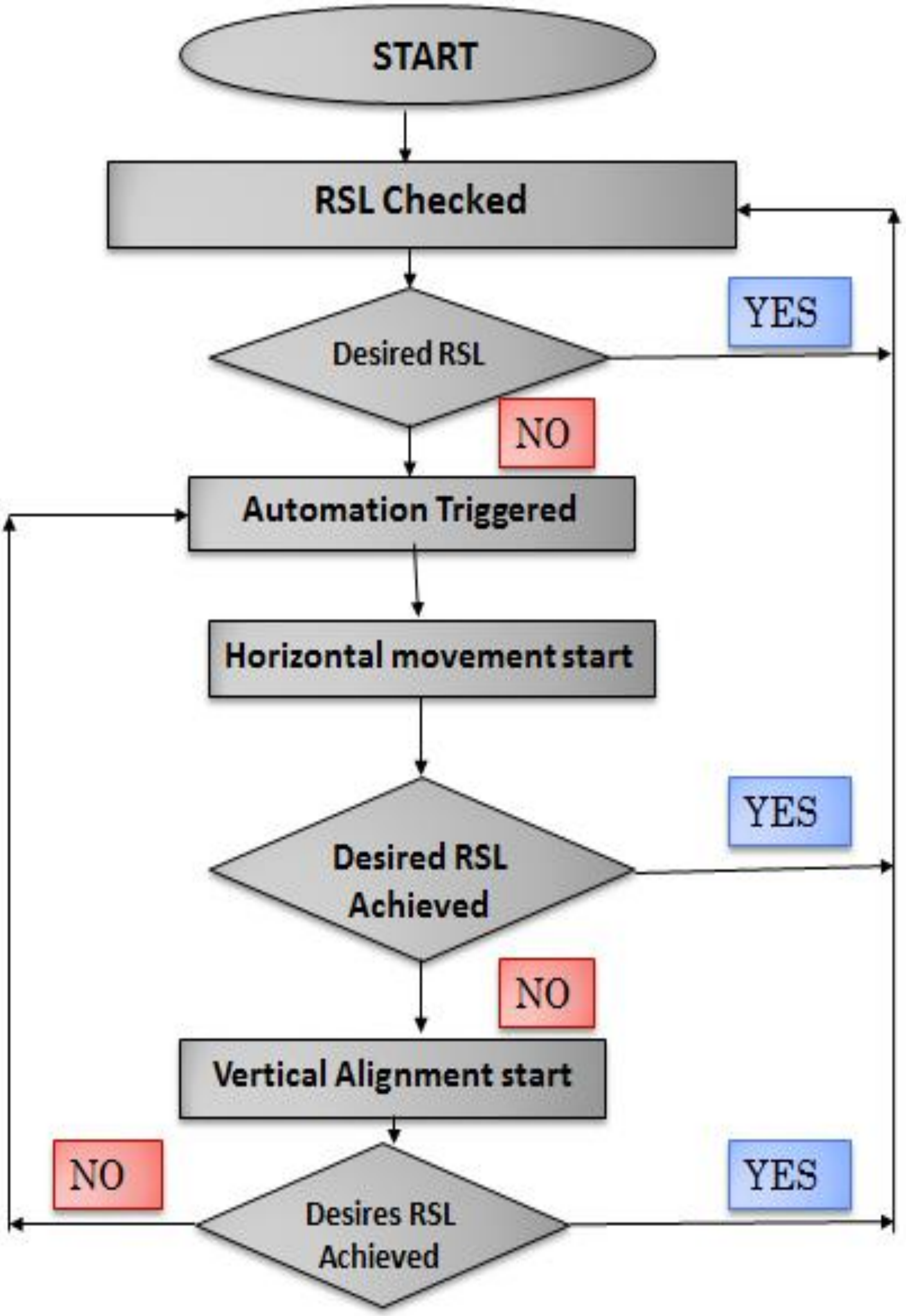


Figure 4.1 Flow Chart

5. DETAILED DESIGN

The purpose of this project is to get rid of the dangerous and cumbersome process of alignment of Microwave dish antennas. We intend to design a mechanism of aligning the dish antenna on the basis of the received signal level (RSL).The microcontroller used in our design continuously monitors the RSL. A feedback system is to be designed via which the RSL will be feedback to the Microcontroller. The Microcontroller is further connected to the H bridges (motor driver circuits) that trigger the motors according to the RSL. When the feedback voltage approaches our defined threshold value, the microcontroller directs the h-bridge to turn off the voltage supply that is being supplied to the motors for rotation. While the motors are rotating, if we get an increasing voltage, the microcontroller directs the circuit to keep on rotating the motors and wherever we will get the desired value the microcontroller will instruct the h-bridge circuit to stop the movement of motors.

5.0. BLOCK DIAGRAM

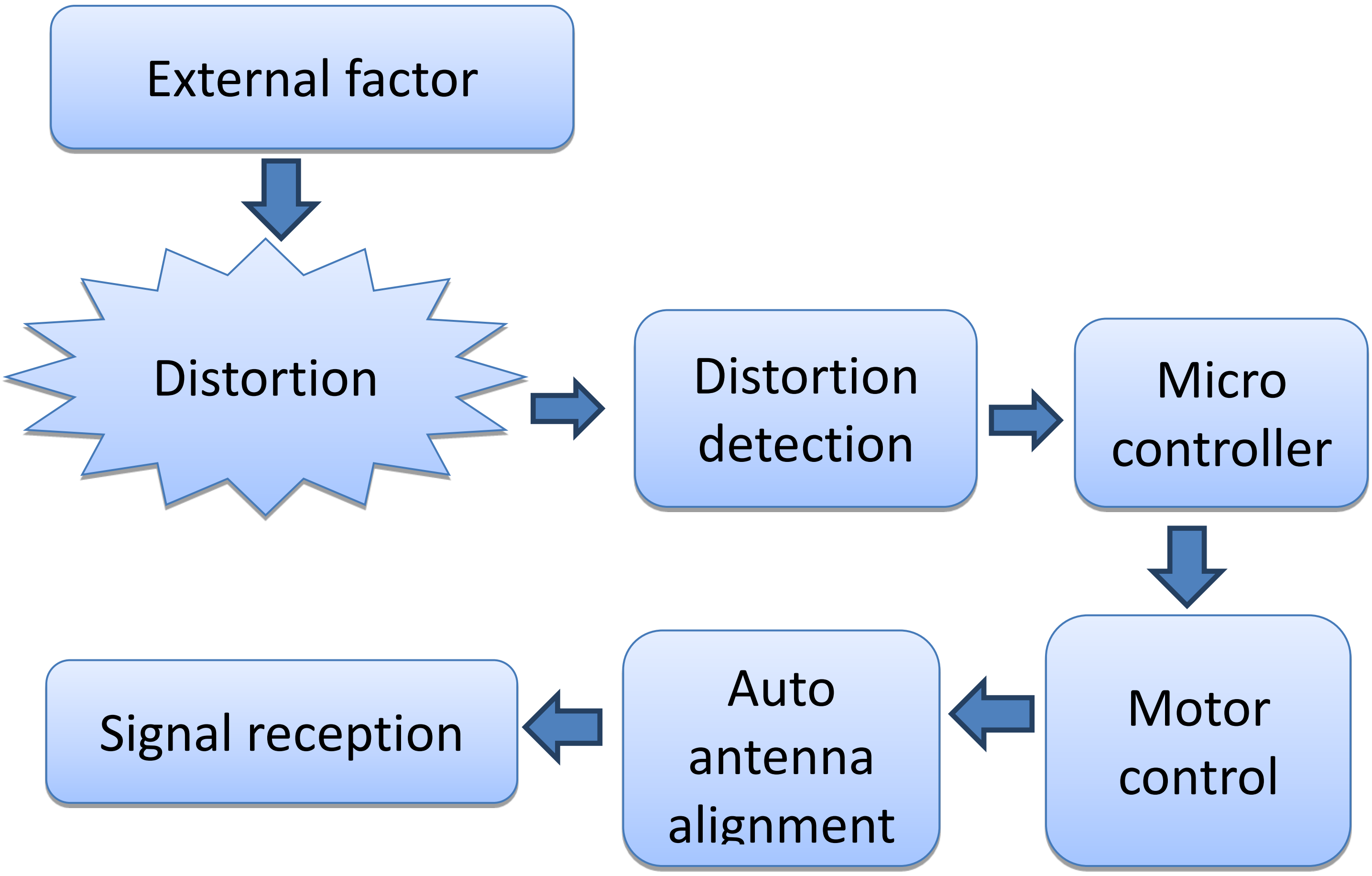


Figure 5.1 Block figure

5.1. DESIGN COMPONENTS

We intend to use two motors, one for horizontal movement and second for vertical movement.

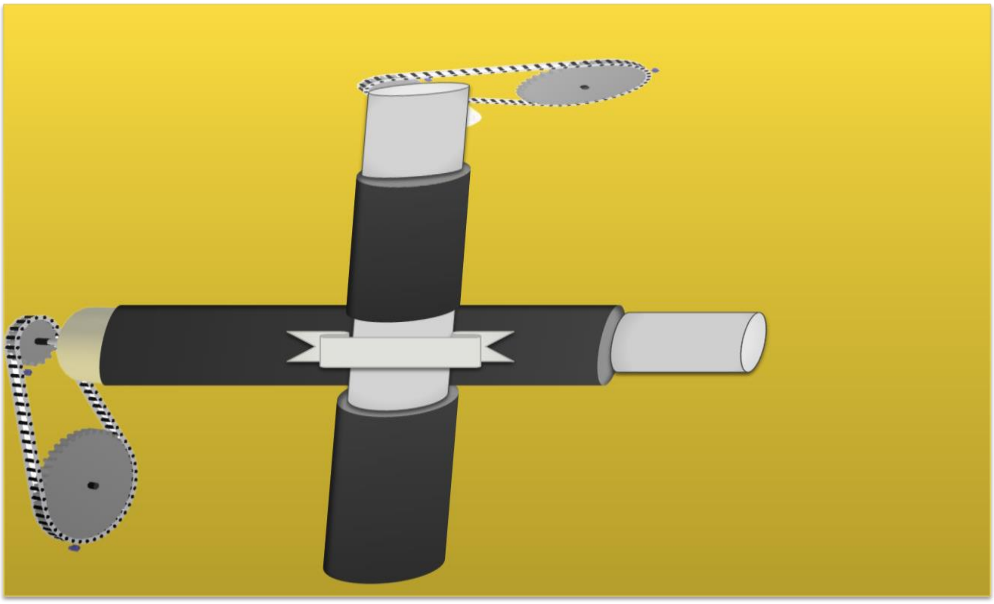


Figure 5.2 Basic hardware design

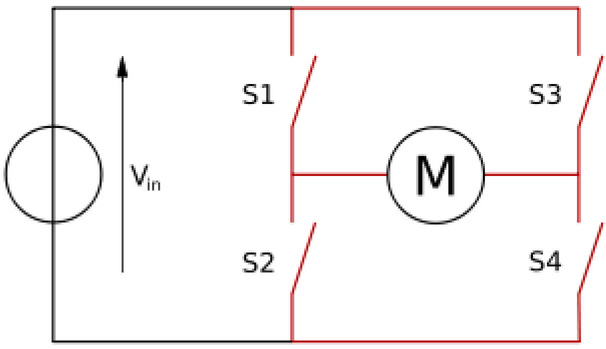
Figure 5.3 Actual hardware design

5.1.0. H-BRIDGE CIRCUITS

An H bridge is an electronic_circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards.

The two motors used in our basic structure are made to operate via circuits known as h-bridge circuits. The h-bridge circuits are trigger through microcontroller, i.e. they get their instructions from microcontroller and move motors in the desired directions.

The h-bridge circuit which we are using is made with transistors because these can be easily used to control a motor's speed.



OPERATION

S1	S2	S3	S4	Result
1	0	0	1	Motor moves right
0	1	1	0	Motor moves left
0	0	0	0	Motor free runs
0	1	0	1	Motor brakes
1	0	1	0	Motor brakes
1	1	0	0	Short Power Supply
0	0	1	1	Short Power Supply
1	1	1	1	Short Power Supply

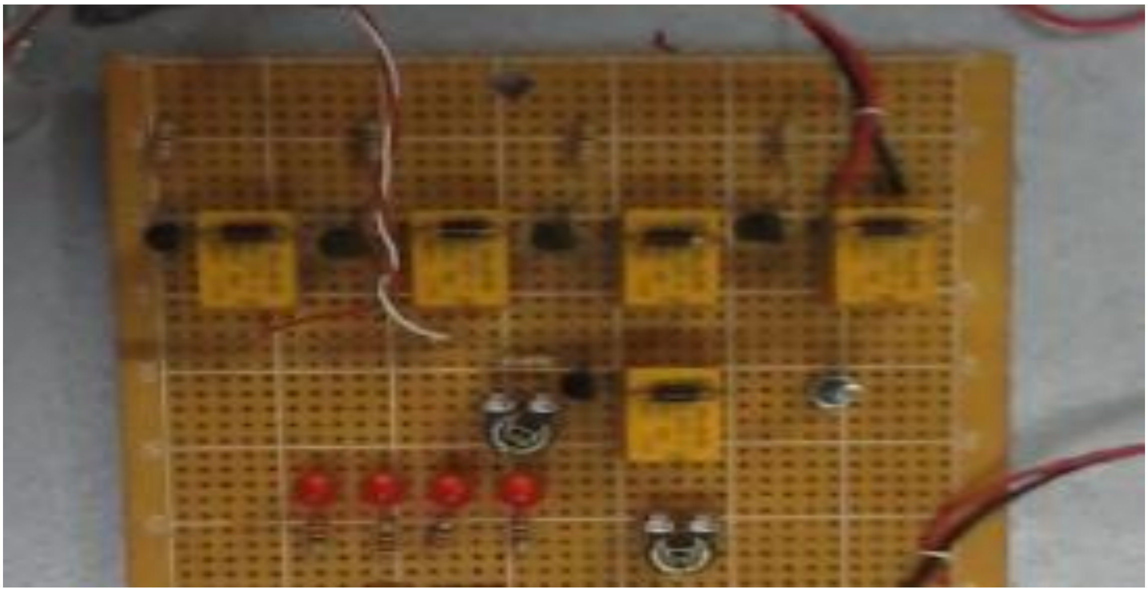


Figure 5.4H Bridge circuit

5.1.1. MICRICONTROLLER CIRCUITS

The basic operations of our project are handled by the circuit in which we will use microcontroller, in this circuit we had used PIC16F877A which is the main decision making device. This decision making device makes decisions and triggers the motors with the help of h-bridge circuits to obtain the correct alignment.

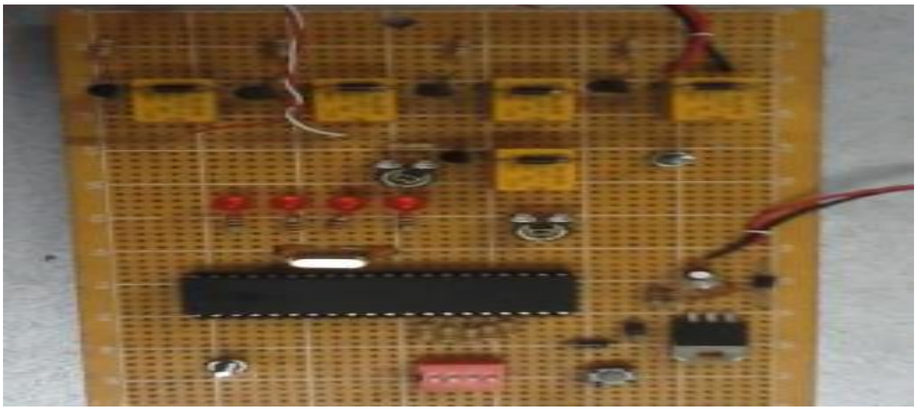


Figure 5.5 Microcontroller circuit

CONFIGURATION OF PIC16F877A

Basic configuration of PIC16F877A is given below:

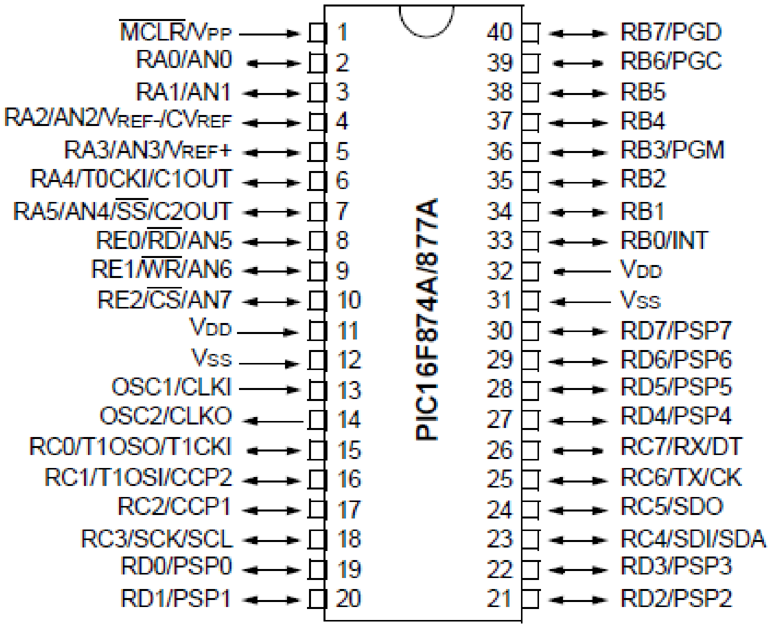


Figure 5.6 Pic 16F877A Configuration

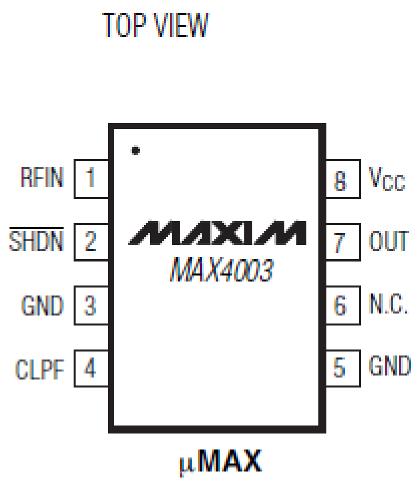
5.1.2. DISH ANTENNA

The main component of our project is microwave dish which is to be aligned automatically with the help of a structure having two types of motors.

Figure 5.6 Dish

5.1.3. RECEIVER

We are using MAX4003 IC at receiver circuit which is a low cost, low power logarithmic amplifier used for detection of the power level of RF power amplifier operating from 100MHz to 2500MHz. In a control loop, the detector output voltage range is approximately 0.36V for the minimum input signal -45dbm, to 1.45V at the maximum input range of 0dbm. Its figure, pin description and technical specifications are as under:-



PIN DESCRIPTION

PIN		NAME	DESCRIPTION
μMAX/ Thin QFN	UCSP		
1	A1	RFIN	RF Input. Requires off-chip 50Ω impedance match.
2	A2	SHDN	Shutdown Input. A logic LOW on SHDN shuts down the entire IC.
3, 5	A3, C3	GND	Ground. Connect to PC board ground plane.
4	B3	CLPF	Lowpass Filter Connection. Connect external capacitor between CLPF and GND to set the control-loop bandwidth.
6	—	N.C.	No Connection. Leave this pin unconnected or connect to GND.
7	C2	OUT	Detector Output. Connect this buffer output to baseband ADC.
8	B1, C1	VCC	Supply Voltage. Bypass with capacitor as close to the pin as possible. The bypass capacitor must not share its ground vias with any other branches.

TECHNICAL CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage	V_{CC}			2.7		5.0	V
Supply Current	I_{CC}	V_{CC} = 5.0V	$V_{\overline{SHDN}}$ = 1.8V		5.9	10	mA
			$V_{\overline{SHDN}}$ = 0.8V		13	30	µA
Shutdown Input Current	$I_{\overline{SHDN}}$	$V_{\overline{SHDN}}$ = 3.0V			5	20	µA
		$V_{\overline{SHDN}}$ = 0V			-0.01	±5	
Logic High Threshold Voltage	V_{IH}			1.8			V
Logic Low Threshold Voltage	V_{IL}					0.8	V
DETECTOR OUTPUT							
Voltage Range	V_{OUT}	RFIN = 0dBm			1.45		V
		RFIN = -45dBm			0.36		
Output Voltage in Shutdown	V_{OUT}	$V_{\overline{SHDN}}$ = 0V			1		mV

5.1.4 MOTORS

The system which we had designed do both azimuth (horizontal axis) as well as vertical movement in such a manner that a single antenna is aligned. In this project horizontal shift and vertical shift have been build independently and then integrated together. A couple of dc gear motors are used to rotate the antenna in horizontal axis as well as vertical axis. Since the antenna has to be aligned on a single point by means of horizontal and vertical movement, no effort is made to drag the antenna itself in different position. In industrial applications a similar setup with high power motors can be used.

The gear motors which we are using are incredibly tough and feature full metal gears to help drive wheels, gears or almost anything else that needs to turn. They have a gear ratio of 100:1 and operate up to 12 volts and deliver a stall torque of 137 oz-in and a max speed of 30 RPM. Its features are as under:-

FEATURES:

- Voltage: 3 - 12 Volts
- Gear ratio: 100:1
- Stall torque: 137 oz – in
- Speed: 30 RPM
- No Load Current: 95 m A
- Stall Current: 0.5A
- Insulation Resistance: 10 MOhm
- Dielectric Strength: 300 VDC
- DC Reversible
- Weight: 4.3 oz

6. ANALYSIS AND EVALUATION:

Simulation of integration of H-Bridge with DC motors.

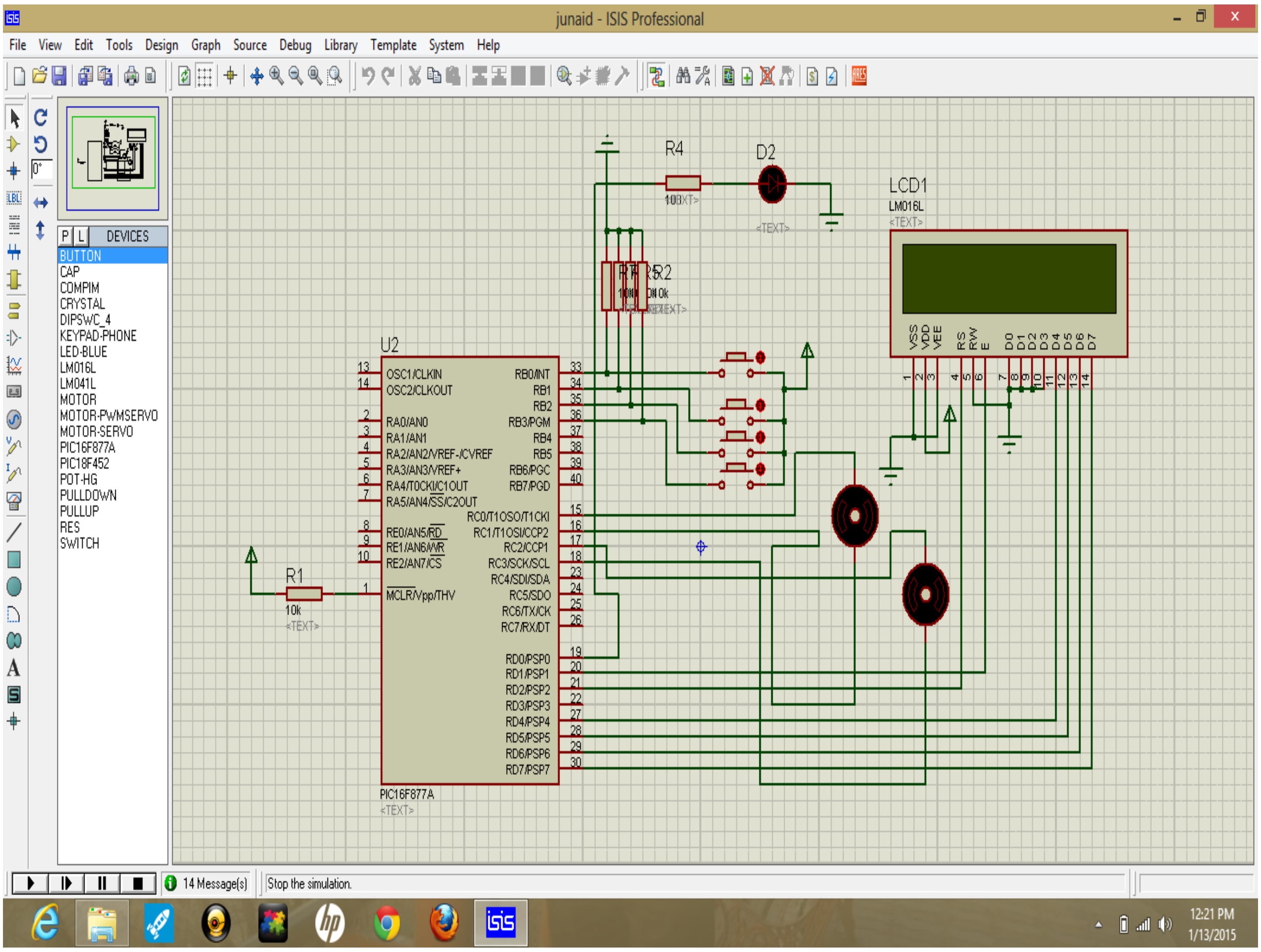


Figure 6.1Simulation circuit 1

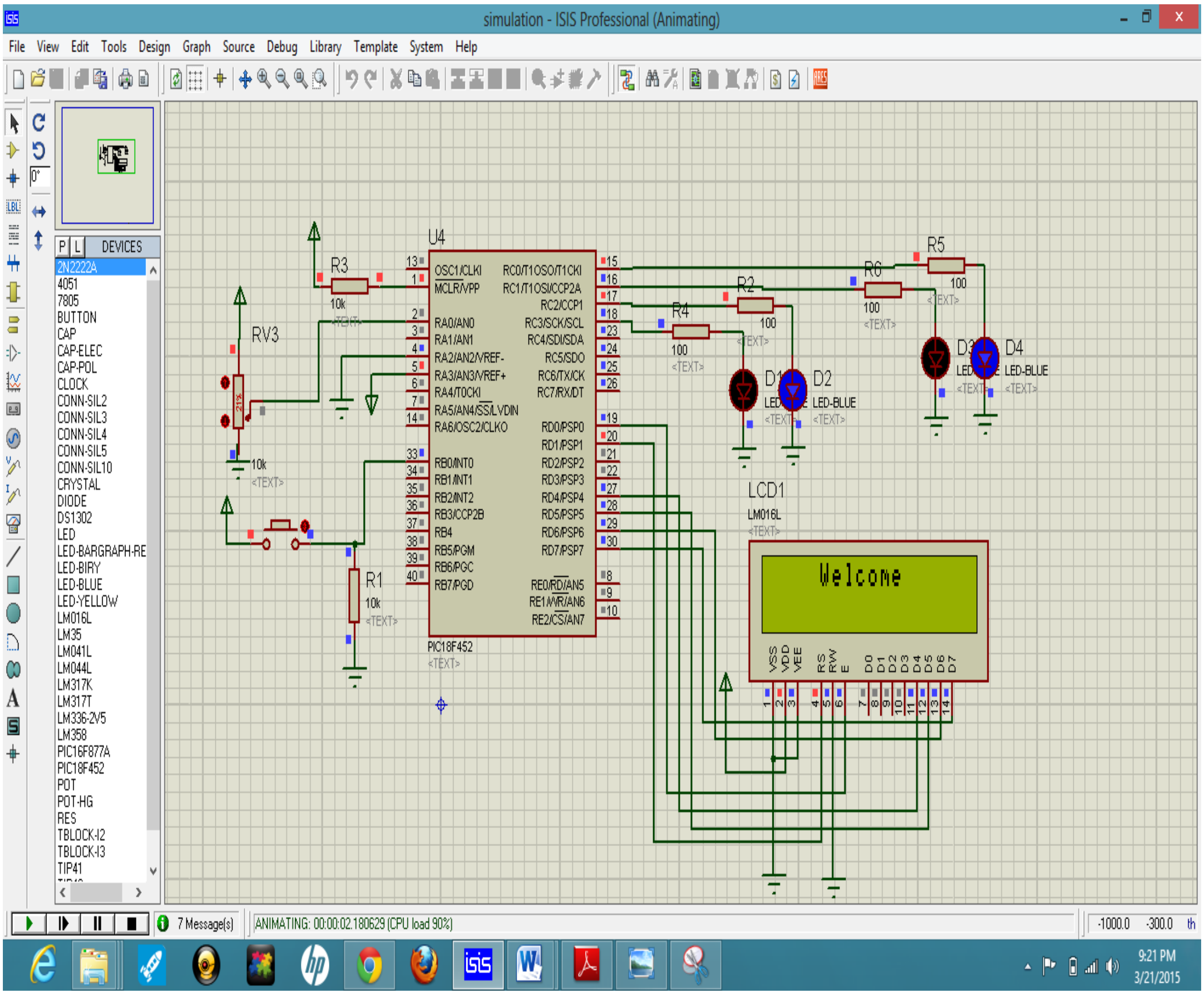


Figure 6.2Simulation circuit 2

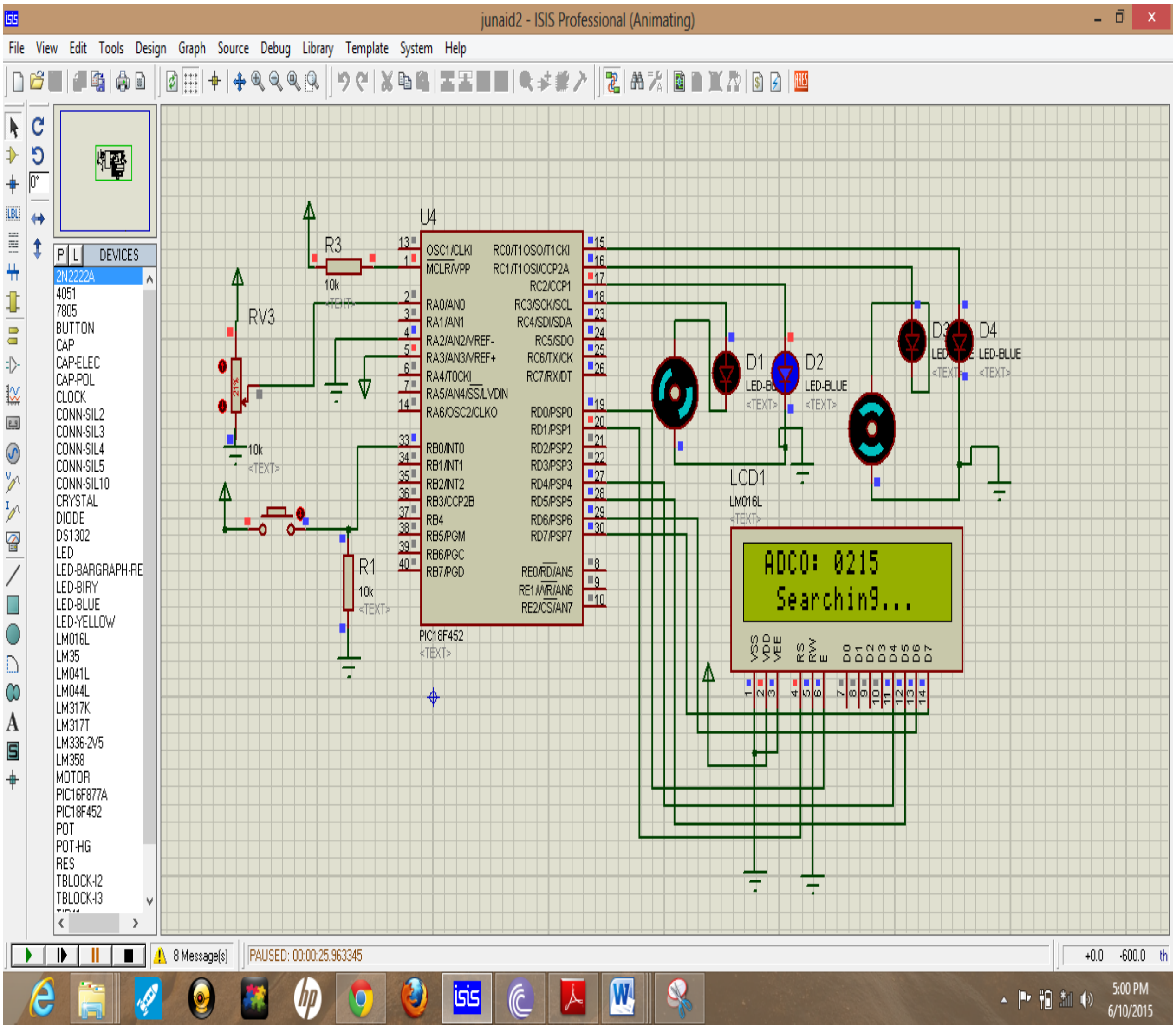


Figure 6.3 Simulation circuit 3

7. Future improvements

7.1. Hardware improvements

1. It would be beneficial to implement a design that would be more light in weight and reliable.
2. Provide adequate power and incredible sensitivity to detect even the smallest possible movement.
3. Provide safe control through our hardware design.
4. We can make low cost hardware design on large scale.

7.2. Software improvements

1. Software-based approach can be done to maintain the required sensitivity of the Dish.
2. Provide smart battery management. It should allow for more efficient energy use that leads to a longer battery life and should add in regenerative braking capability.
3. No processing delays should be involved

7.3. Future enhancement

The basic idea of designing an antenna that aligns itself without human intervention has been presented but there is a huge potential for advancements.

1. The system is designed and tested on a single station while other is kept stationary, Further enhancement can be done making both terminals moveable.
2. The response time for antenna alignment can be improved.
3. One motor can be used for both the alignments.
4. The size of the basic structure can be reduced.

8. Conclusion

Modern communication system is equipped with lot of sophisticated devices and the system must be immune to all critical situations to give a reliable and robust service. It is essential to maximize the network availability at all times. In this report, an automated antenna alignment has been made possible by means of an automation system and modeled antennas. MW link works on LOS while directional antennas of BTS terminals can ensure a lossless transmission. Multiple factors that account for response time of automation system are devised for locomotion in both azimuth as well as vertical tilting. A system has been presented which ensures that the antenna and its corresponding main lobes are set to get maximum RSL. Since the alignment is done autonomously, therefore it will make sure that the down time is kept at minimal level. All the experiment and implementation is done on a modeled solution though software design used can easily be replicated on active network; hardware tolls do give a feel of actual ICT atmosphere.

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APPENDIX A: (Manual)

```
Device = 16F877A

Xtal = 4

All_Digital=true

Declare LCD_Type 0'in case we use alphanumeric then type 0 if graphical then 1

Declare LCD_DTPin PORTD.4 'this show that 4 pin interface with lcd and 4 data pins will start from d4..d7

Declare LCD_RSPin PORTD.2 'declaring lcd reset pin

Declare LCD_ENPin PORTD.1 'declaring enable pin

Declare LCD_Lines 2  'telling how much rows lcd has

Symbol button1=PORTB.0

Symbol button2=PORTB.1

Symbol button3=PORTB.2

Symbol button4=PORTB.3

Cls

'Print At 1,1," Welcome to FYP"

'Print At 2,1,"    Project    "

DelayMS 2000

While 1=1

If button1 = 1 Then

DelayMS 1000

'Print At 1,1," short ckt in   "

'Print At 2,1,"transmision Line"

High PORTC.0''on alarm pin

DelayMS 2000

Low PORTC.0  ''off alarm pin

DelayMS 1000

EndIf
```

```
If button2 = 1 Then
DelayMS 1000

'Print At 1,1," open crkt in   "
'Print At 2,1,"transmision line"

High PORTC.1
DelayMS 2000
Low PORTC.1
DelayMS 1000

EndIf

If button3 = 1 Then
DelayMS 1000

'Print At 1,1,"repairing now in"
'Print At 2,1,"transmision Line"

High PORTC.2
DelayMS 2000
Low PORTC.2
DelayMS 1000
```

APPENDIX B: (Automation)

```
Device = 16F877A
     Device = 18F452
        Xtal = 20

            LCD_DTPin = PORTD.4     'lcd interface
            LCD_RSPin = PORTD.1
            LCD_ENPin = PORTD.0
            LCD_Interface = 4 ' 4-bit Interface
            LCD_Lines = 4
            LCD_Type = 0      'alpha numeric
            LCD_CommandUs = 2000'lcd date should be pasted after this
time
            LCD_DataUs = 50

        Declare Hserial_Baud = 9600                   ' Set baud rate
to 9600    '300,1200,4800,9600,19200,38400,11500

Hserial_RCSTA = %10010000       ' Enable serial port and continuous
receive

Hserial_TXSTA = %00100100       ' Enable transmit and asynchronous
mode

Hserial_Clear = On                       ' Enable Error clearing on
received characters

   '     PORTB_PULLUPS=true 'portb pull up

        ''''''''''''''''''''''''''''''''''
        Dim Adc0 As Word
        Dim delay4sec As Dword
        Dim i As Dword


'''''''''''
Symbol Motr1a=PORTC.0
Symbol Motr1b=PORTC.1

''''''''''
Symbol Motr2a=PORTC.2
Symbol Motr2b=PORTC.3


   Print At 1,4, " Welcome "
               Motr1a=1
               Motr1b=0

               Motr2a=1
               Motr2b=0

               DelayMS 6000
               Motr1a=0
           Motr1b=0
           Motr2a=0
           Motr2b=0
           DelayMS 3000
      Cls
       delay4sec= 12000
```

```
While 1=1

For  i=1 To delay4sec Step 1
 GoSub get_adc

If PORTB.0=1 Or Adc0>500 Then
Print At 2,2, " Found        "
    Motr1a=0
    Motr1b=0
    Motr2a=0
    Motr2b=0

ElseIf i<=delay4sec/2 And Adc0<450 Then
 Print At 2,2, " Searching... "
        Motr2a=0
        Motr2b=1
        If i=delay4sec/2 Then
        Motr2a=0
        Motr2b=0
        DelayMS 2000
        Motr1a=0
        Motr1b=1
        DelayMS 1000
        Motr1a=0
        Motr1b=0
        DelayMS 2000
        EndIf

ElseIf i>delay4sec/2 And Adc0<450 Then
  Print At 2,2, " Searching... "
        Motr2a=1
        Motr2b=0
        If i=delay4sec-2  Then
        i=1
        Motr2a=0
        Motr2b=0
        DelayMS 2000
        Motr1a=0
        Motr1b=1
        DelayMS 1000
        Motr1a=0
        Motr1b=0
        DelayMS 2000
        EndIf

 EndIf


Next

Wend



get_adc:
      Adc0=ADIn 0
      Print At 1,1, " ADCO: " ,Dec4 Adc0
      Return
```