Sudan University of Science and Technology
College of Graduate Studies

Two Dimensional Automatic Alignment of a Satellite Parabolic Antenna

الضبط الأتوماتيكي ثنائي الأبعاد لهوائي قمر إصطناعي ذو قطع مكافئ

A Thesis submitted As Partial Fulfillment of Requirement for M.Sc. Degree in Mechatronics Engineering

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بسم الله الرحمن الرحيم

قال تعالي:

اللَّهُ نُورُ السَّمَوَاتِ وَالْأَرْضِ مَثَلُ نُورِهِ كَمِشْكَاةٍ فِيهَا مِصْبَاحٌ الْمِصْبَاحُ فِي زُجَاجَةٍ الزُّجَاجَةُ كَأَنَّهَا كَوْكَبٌ دُرِّيٌّ يُوقَدُ مِنْ شَجَرَةٍ مُبَارَكَةٍ زَيْتُونَةٍ لَا شَرْقِيَّةٍ وَلَا غَرْبِيَّةٍ يَكَادُ زَيْتُهَا يُضِيءُ وَلَوْ لَمْ تَمْسَسْهُ نَارٌ نُورٌ عَلَى نُورٍ يَهْدِي اللَّهُ لِنُورِهِ مَنْ يَشَاءُ وَيَضْرِبُ اللَّهُ الْأَمْثَالَ لِلنَّاسِ وَاللَّهُ بِكُلِّ شَيْءٍ عَلِيم (35)

صدق الله العظيم

سورة النور (الأية 35)

Dedication

I dedicate this work to

my family and many friends.
To each one taught me, and took my hand, and Lighted me through science and knowledge. To those encouraged me in my journey to excellence and success.
To each one supported me and stood by me. To all of the success was his way, and the goal of excellence, and excellence him.
Thanks to all of you and appreciation and respect.

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This thesis is a culmination of the contributions of many individuals who supported me, directly or indirectly, in the past few years. Firstly, I would like to a very special thank my supervisor **Dr. Fath Elrahman Ismael** For the ongoing support and encouragement. I also thank my wonderful family for their unwavering faith in me during times when the finish-line was not in sight.

Thank to my friends - thank you for motivation and memories. You made the journey a much easier one.

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Abstract

Satellite dish receivers have become popular in recent years primarily for use in home television receiving systems. Satellite dish receivers and satellite dish transmitters are highly directional antennas. As a result they must be precisely aimed at a desired broadcasting satellite for proper operation. The traditional method for tuning or aligning satellite antenna to specific satellite is done manually which it is not precise. a design to align satellite antenna automatically to specific satellite has been presented in this thesis. To design this system firstly initial design was built using proteus and bascom avr ID.After that antenna was motorized with two DC Motor ,one for horizontal movement and the other for vertical movement. Then to control movement of DC motors to move the two motors in pattern of pulses a controller was been used. When controller get a good signal level. It will save motors positions in its EEPROM. this was done according to specific program built in microcontroller memory. controller used in this system was avr atmega 32 programmed by using BASCOM AVR ID. Then test and evaluation process was done for the proposed system. Finally, conclude that the use of the proposed solution for alignment process was made and it was been easy and quickly. The results of the simulation was compatible with what is expected from using this technique.

المستخلص

هوائيات الأقمار الاصطناعية أصبحت شائعه وكثيره الاستخدام في حياتنا اليومية المعاصرة . حيث تستخدم لاستقبال وإرسال إشارات البث التلفزيوني الفضائي . هوائيات الأقمار الاصطناعية (هوائي مرسل او مستقبل) يتم توليفها اتجاهيا . لذلك يجب أن تكون عمليه الضبط الاتجاهي دقيقه لكي تعمل هذه الهوائيات . الطريقة التقليدية للضبط تتم بصوره يدويه مما يجعلها غير دقيقه وتحتاج الى وقت اكثر . في هذا البحث تم تقديم طريقه اتوماتيكيه لضبط او توليف هوائي الأقمار الاصطناعية نحو قمر معين . لتصميم هذا النظام تم أولا تصميم نموذج اولي وذلك باستخدام برنامج المحاكاة بروتوس وبيئة برمجيه الباسكوم . ثم بعد ذلك تم إضافة محركات تيار مستمرللهوائي . المحرك الأول يستخدم لتحريك الهوائي أفقياً أما المحرك الثاني يستخدم لتحريك الهوائي راسيا . تم بعد ذلك استخدام متحكمه لتقوم بالتحكم في تشغيل هذه المحركات وفق ألية حركه نبضية الشكل معينه للبحث عن الإشارة . عندما تصبح جوده الإشارة كبيره تقوم المتحكمة بحفظ موقع القمر في ذاكرتها وذلك بإرجاع الهوائي الى الاتجاه الابتدائي . وذلك يتم باستخدام برنامج محفوظ في ذاكره المتحكمة . المتحكمة التي تم استخدامها في تصميم هذا النظام هي المتحكم الدقيق ميقا من شركه أتمل . تم اختبار هذا النموذج حيث وجد انه يقوم بعمليه التوليف بصوره سريعه ودقيقه . تم الحصول على نتائج من برنامج المحاكاة توافق النتائج المتوقعة لاستخدام هذه الألية المقترحة في عمليه التوليف او الضبط .

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List of Abbreviations

AD	Analog-to-Digital
AZ	Azimuth
CAG	Calibrated Adjustable Gnomon
CCW	Counterclockwise
CMOS	Complementary metal–oxide–semiconductor
C/N	Carrier-To-Noise
CPU	Central Processing Unit
CW	Clockwise
DC	Direct Current
DTMF	Dual Tone Multi Frequency
EEPROM	Electrically Erasable Programmable Read-Only Memory
ELE	Elevation
FM	Frequency modulation
GEO	Geosynchronous Orbit
IC	Integrated Circuit
IO	Input Output
IR	Infrared
LAN	Local Area Network
LED	Light Emitting Diode
LEO	Low Earth Orbit
LNB	Low Noise Block

MCU	Microcontroller Unit
meo	MEOMedium Earth Orbit
MIPS	Million Instructions Per Second
PMDC	Permanent Magnet DC Motor
SHF	Super-High Frequency
SRAM	Static Random-Access Memory
TTL	Transistor to Transistor logic
TV	Television
UHF	Ultra High Frequency
WAN	Wide Area Network

Chapter One

INTRODUCTION

Chapter One

INTRODUCTION

1.1 Preface

Control systems are an integral part of modern society. Numerous applications are all around us: The rockets fire, and the space shuttle lifts off to earth orbit; in splashing cooling water, a metallic part is automatically machined; a self-guided vehicle delivering material to workstations in an aerospace assembly plant glides along the floor seeking its destination. These are just a few examples of the automatically controlled systems that we can create. We are not the only creators of automatically controlled systems; these systems also exist in nature. Within our own bodies are numerous control systems, such as the pancreas, which regulates our blood sugar. In time of "fight or flight," our adrenaline increases along with our heart rate, causing more oxygen to be delivered to our cells. Our eyes follow a moving object to keep it in view; our hands grasp the object and place it precisely at a predetermined location.A position control system converts a position input command to a position output response. Position control systems find widespread applications in antennas, robot arms, and computer disk drives[1].

1.2 Problem Statement

Traditional method for tuning or aligning satellite antenna to specific satellite is done manually .It needs two persons or at least one and it takes long time to be done.Also it is not precise.

1.3 Proposed Solution

This thesis presents a simple design of system for eliminating manual tuning or alignment of satellite antenna.This system makes this process to be done in less time and precisely.

1.4 Objectives

- To design a control circuit for two coordinates antenna control and orientation using MCU (atmega32 avr) and bascom avr software.
- To design a control system for azimuth and elevation axis for antenna using DC motors.
- To Simulate the designed system on proteus software program.
- To Implement a pro-type system for the designed system.
- To Perform evaluation for the system .

1.5 Methodology

The main idea of this work is to design automatic satellite antenna alignment system.To design this system firstly initial design was built using proteus and bascom avr .After that antenna was motorized with two DC Motor ,one for horizontal movement and the other for vertical movement.Then a controller was used to control movement of DC motors to move the two motors in pattern of pulses .When controller get a good signal level .It will save motors positions in its EEPROM. this done according to specific program built in microcontroller memory. controller used in this system was avr atmega 32 programmed by using BASCOM AVR ID.Then test and evaluation process was done for the proposed system .

1.6 Research Outlines

This research consists of five chapters:

- **Chapter One** consists of the problem statement,proposed solution , objective , methodology .
- **Chapter Two** contains Literature review on the orientation and control of antenna and control of stepper motor.
- **Chapter Three** contains description of hardware used in the system, hardware design, circuit and hardware connections.
- **Chapter Four** contains result and discussion of the implementation of (MCU based two co-ordinates antenna orientation and control) system.
- **Chapter Five** consists of Conclusion and Recommendations.

Chapter Two

LITERATURE REVIEW

Chapter Two

LITERATURE REVIEW

2.1 Background

2.1.1 Satellite Communication

Satellite communication is one of the most impressive spin-offs from the space programs, and has made a major contribution to the pattern of international communications. A communication satellite is basically an electronic communication package placed in orbit whose prime objective is to initiate or assist communication transmission of information or messages from one point to another through space. The information transferred most often corresponds to voice (telephone), video (television), and digital data. Communication involves the transfer of information between a source and a user. An obvious example of information transfer is through terrestrial media, through the use of wire lines, coaxial cables, optical fibers, or a combination of these media. Communication satellites may involve other important communication subsystems as well. In this instance, the satellites need to be monitored for position location in order to instantaneously return an upwardly transmitting (uplink) ranging waveform for tracking from an earth terminal (or station). The term earth terminal refers collectively to the terrestrial equipment complex concerned with transmitting signals to and receiving signals from the satellite. The earth terminal configurations vary widely with various types of systems and terminal sizes. An earth terminal can be fixed and mobile land based, sea based, or air-

borne. Fixed terminals, used in military and commercial systems, are large and may incorporate network control center functions. Transportable terminals are movable but are intended to operate from a fixed location, that is, a spot that does not move[2].
the use of satellite in communication system is very much a fact of everyday life as is evidenced by the many homes equipped with antennas or (dishes) used for reception of satellite television.what may not be so well known is that satellites form an essential part of telecommunication systems worldwide carrying large amounts of data and telephone traffic in addition to television signals[3].

2.1.2 Types of Satellite Orbits

There are three types of orbits used in satellite communications,GEO,LEO and MEO as shown in figure 2.1. satellite communications circle the earth in this three orbits: geostationary orbit (GEO), low earth orbit (LEO) and medium earth orbit (MEO). A GEO satellite follows the direction of the Earth's rotation from 22,000 miles above the Equator and appears as a fixed, static point to any observer or antenna tracking it on the ground. While used for applications such as broadcast communications and weather satellites, communication through a GEO system becomes more difficult as the ground observer's latitude increases the further north or south it travels due to occurrences such as atmospheric refraction, thermal emission, line-of-sight obstructions and signal reflections from structures on the ground. LEO applies to objects in motion approximately 1,000 miles above the Earth which includes all manned space stations and the majority of satellites. Moving objects in a MEO system, often called "fiber-in-the-sky," orbit between GEO and LEO at approximately 5,000 to 10,000 miles above the Earth. The primary difference between MEO and LEO systems as compared to the majority of communications satellites in geostationary orbit is altitude. Location is everything. MEO and LEO satellites travel

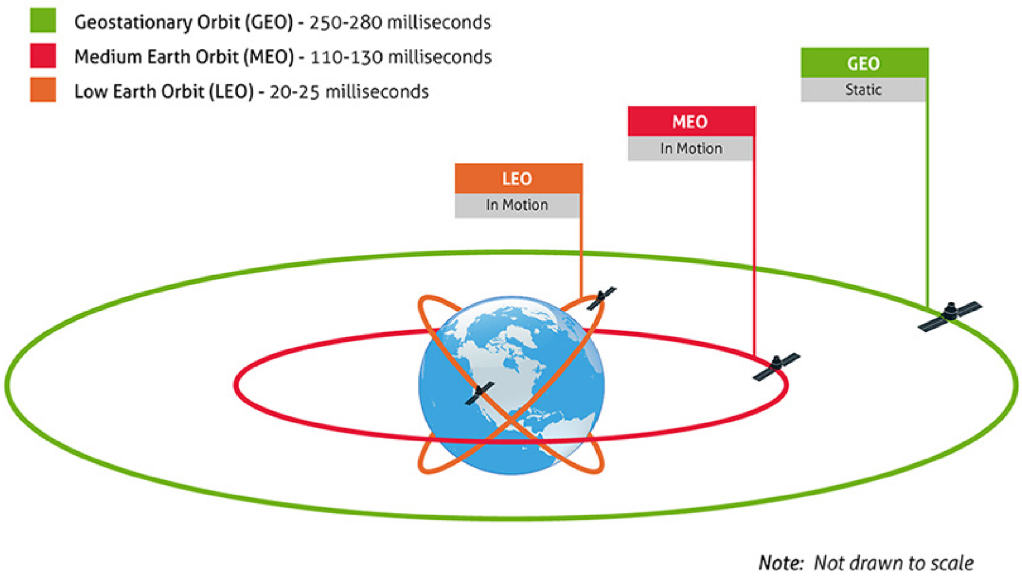


Figure 2.1: Satellite orbits

overhead at all times, instead of tracking with a fixed point on Earth as GEO satellites do. This type of orbit allows them to provide constant coverage through a constellation of several satellites that are closer to Earth, offering a significant performance advantage with low latency .

2.1.3 Geostationary Orbit

a geostationary satellite is one that appears to be stationary relative to the earth . there is only one geostationary orbit but this is occupied by a large number of satellites it is the most widely used orbit by far for the very practical reason that earth station do not need to track geostationary satellites (except for certain very high gain earth station antennas that require a limited range of tracking)[3].
the first and obvious requirement for a geostationary satellite is that it must have zero inclination .any other inclination would carry the satellite over some range of latitudes and hence would not be geostationary.thus the geostationary orbit must lie in the earth's equatorial plane .the second obvious requirement is that geostationary satellites should travel eastward at the same rotational velocity as the earth .since this velocity is constant

then from Kepler's law it can be deduced that the orbit must be circular[3]. Important parameters in satellite communication are the inclination and elevation angles.

2.1.4 Definitions of Satellite Position Angles

The look angles are the coordinates to which an earth station antenna must be pointed to communicate with a satellite[2].
Azimuth angle (Az) as shown in figure 2.2 is the angle at which the earth station's disk is pointing at the horizon[2].
the elevation angle as shown in figure 2.2 is the angle by which the antenna boresight must be rotated to lock on to the satellite[2].

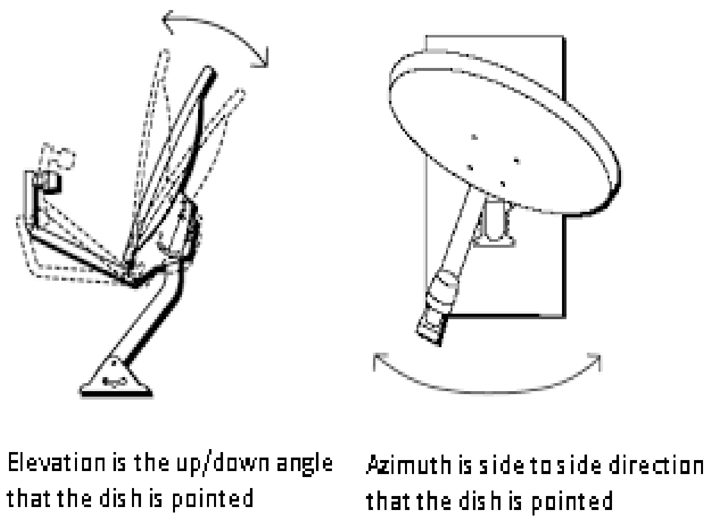


Figure 2.2: Azimuth and Elevation Angles

Skew angle as shown in figure 2.3 refers to the polarization angle of the electric field. The term 'Dish Skew' refers to the dish tilt necessary to get the satellite dish position such that the LNB will be in exact alignment with the electric field of the incoming satellite signals. Setting the dish skew is necessary only when pointing to more than a single satellite[4].

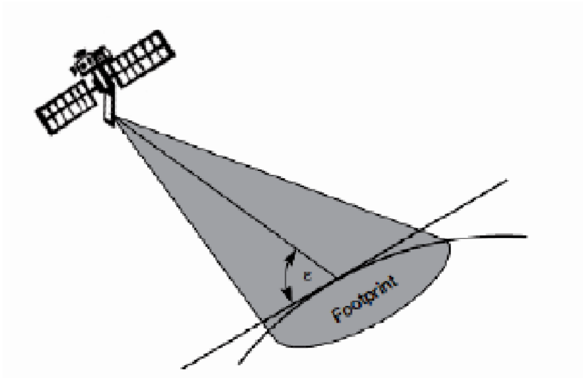


Figure 2.4: inclination angle

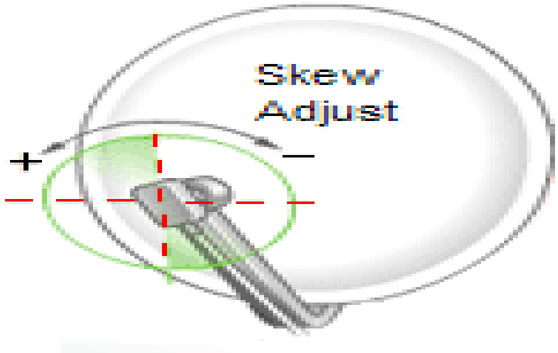


Figure 2.3: skew angle

2.1.5 Inclination Angle

The inclination angle as shown in figure 2.4 is defined between the equatorial plane and the plane described by the satellite orbit. An inclination angle of 0 degrees means that the satellite is exactly above the equator. If the satellite does not have a circular orbit, the closest point to the earth is called the perigee.

2.1.6 Parabolic Antenna

A parabolic antenna is an antenna that uses a parabolic reflector, a curved surface with the cross-sectional shape of a parabola, to direct the radio waves. The most common form is shaped like a dish and is popularly called a dish antenna or parabolic dish. The main advantage of a parabolic antenna is that it has high directivity. It functions similarly to a searchlight or flashlight reflector to direct the radio waves in a narrow beam, or receive radio waves from one particular direction only. Parabolic antennas have some of the highest gains, meaning that they can produce the narrowest beamwidths, of any antenna type. In order to achieve narrow beamwidths, the parabolic reflector must be much larger than the wavelength of the radio waves used, so parabolic antennas are used in the high frequency part of the radio spectrum, at UHF and microwave (SHF) frequencies, at which the wavelengths are small enough that conveniently-sized reflectors can be used. Parabolic antennas are used as high-gain antennas for point-to-point communications, in applications such as microwave relay links that carry telephone and television signals between nearby cities, wireless WAN/LAN links for data communications, satellite communications and spacecraft communication antennas. They are also used in radio telescopes.

The other large use of parabolic antennas is for radar antennas, in which there is a need to transmit a narrow beam of radio waves to locate objects like ships, airplanes, and guided missiles. With the advent of home satellite television receivers, parabolic antennas have become a common feature of the landscapes of modern countries.

2.1.7 Polarization

The pattern of electric and magnetic fields at the mouth of a parabolic antenna is simply a scaled up image of the fields radiated by the feed antenna, so the polarization is determined by the feed antenna. In order to achieve maximum gain, the feed antenna in the transmitting and receiving antenna must have the same polarization. For example, a vertical dipole feed antenna will radiate a beam of radio waves with their electric field vertical, called vertical polarization. The receiving feed antenna must also have vertical polarization to receive them; if the feed is horizontal (horizontal polarization) the antenna will suffer a severe loss of gain.

To increase the data rate, some parabolic antennas transmit two separate radio channels on the same frequency with orthogonal polarization, using separate feed antennas; this is called a dual polarization antenna. For example, satellite television signals are transmitted from the satellite on two separate channels at the same frequency using right and left circular polarization. In a home satellite dish, these are received by two small monopole antennas in the feed horn, oriented at right angles. Each antenna is connected to a separate receiver.

2.1.8 Micro-controller

Microcontrollers are general purpose microprocessors which have additional parts that allow them to control external devices. Basically, a microcontroller executes a user program which is loaded in its program memory. Under the control of this program, data is received from external devices (inputs), manipulated and then data is sent to external output devices. A microcontroller is a very powerful tool that allows a designer to create sophisticated I/O data manipulation algorithms. Microcontrollers are classified by the number of bits in a data word. 8-bit microcontrollers are the most popular ones and are used in many applications. 16-bit and 32-bit microcontrollers are much more powerful, but usually more expensive and not required in many small to medium general purpose applications where microcontrollers are used.
Figure 3.3 shows the simplest microcontroller architecture .It consists of a microprocessor, memory, and I/O. The microprocessor consists of a central processing unit (CPU) and the control unit (CU). The CPU is the brain of a microprocessor and is where all of the arithmetic and logical operations are performed. The control unit controls the internal operations of the microprocessor and sends out control signals to other parts of the microprocessor to carry out the required instructions[5].
Memory is an important part of a microcomputer system. Depending upon the application, we can classify memories into two groups: program mem-

ory and data memory. Program memory stores all the program code and this memory is usually non-volatile, i.e. data is not lost after the removal of power. Data memory is where the temporary user data is stored during the various arithmetic and logical operations. Data memories are usually volatile[5].

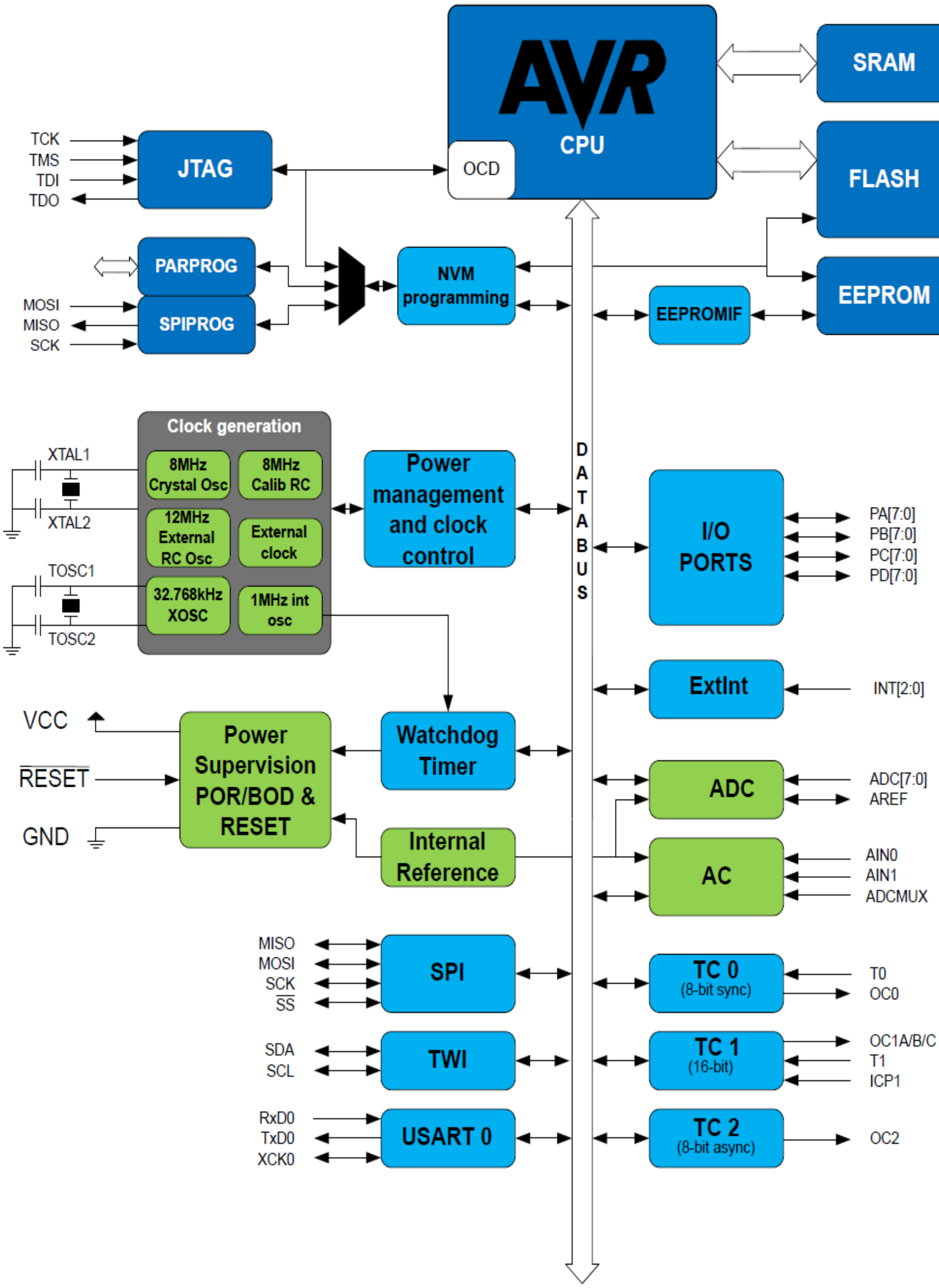


Figure 2.5: Atmega32 internal architecture

The data memory is split up in different type :
-Aregister file with 32 registers of 8bit width .all processor of the AVR family have this register file[6].
-64 I/O registers of 8 bits each all the processors do not have all 64 registers. some have more than the others[6].
-internal SRAM : this is available on most of the AVR processors.the amount of SRAM varies between 128 byte to 4K byte .the SRAM is used for stack as well as storing variables[6].
-EXTERNAL SRAM this memory is possible only on the larger processors of the AVR family .those processors that have external data and memory access port[6].
EEPROM :this memory is available on almost all avr processors .this memory can be written to about 100000 times[6].

2.1.8.1 Atmel AVR Atmega32

The Atmel® ATmega32A is a low-power CMOS 8-bit microcontroller based on the AVR® enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32A achieves throughputs close to 1MIPS per MHz. This empowers system designer to optimize the device for power consumption versus processing speed.

2.1.8.2 Atmel ATmega32A pins

Figure 3.4 shows pins of atmega32 micro-controller .which consists of 40 pins .

- VCC
  Digital supply voltage.

- GND
  Ground.

- PortA (PA7:PA0)
  Port A serves as the analog inputs to the A/D Converter.Port A also

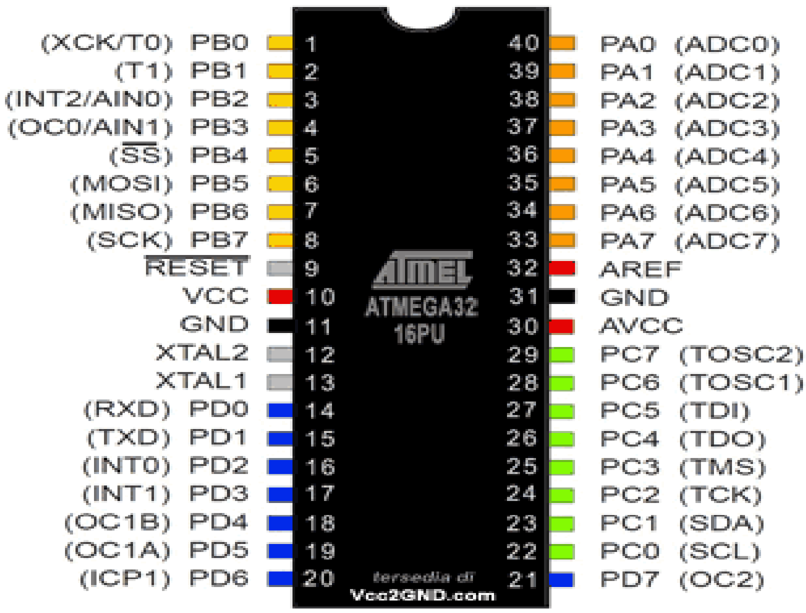


Figure 2.6: MCU pin-out

serves as an 8-bit bi-directional I/O port, if the A/D Converter is not used. Port pins can provide internal pull-up resistors (selected for each bit). The Port A output buffers have symmetrical drive characteristics with both high sink and source capability. When pins PA0 to PA7 are used as inputs and are externally pulled low, they will source current if the internal pull-up resistors are activated. The Port A pins are tristated when a reset condition becomes active, even if the clock is not running.

- Port B (PB7:PB0)

  Port B is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port B output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port B pins that are externally pulled low will source current if the pull-up resistors are activated. The Port B pins are tristated when a reset condition becomes active, even if the clock is not running. Port B also serves the functions of various special features of the ATmega32A as listed in Alternate Functions of Port B.

- Port C (PC7:PC0)

  Port C is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port C output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port C pins that are externally pulled low will source current if the pull-up resistors are activated. The Port C pins are tri-stated when a reset condition becomes active, even if the clock is not running. If the JTAG interface is enabled, the pull-up resistors on pins PC5(TDI), PC3(TMS) and PC2(TCK) will be activated even if a reset occurs. The TD0 pin is tristated unless TAP states that shift out data are entered. Port C also serves the functions of the JTAG interface and other special features of the ATmega32A as listed in Alternate Functions of Port C.

- Port D (PD7:PD0)
  Port D is an 8-bit bi-directional I/O port with internal pull-up resistors (selected for each bit). The Port D output buffers have symmetrical drive characteristics with both high sink and source capability. As inputs, Port D pins that are externally pulled low will source current if the pull-up resistors are activated. The Port D pins are tristated when a reset condition becomes active, even if the clock is not running. Port D also serves the functions of various special features of the ATmega32A as listed in Alternate Functions of Port D.

- RESET
  Reset input. A low level on this pin for longer than the minimum pulse length will generate a reset, even if the clock is not running. The minimum pulse length is given in System and Reset Characteristics. Shorter pulses are not guaranteed to generate a reset.

- XTAL1
  Input to the inverting Oscillator amplifier and input to the internal clock operating circuit.

- XTAL2
  Output from the inverting Oscillator amplifier.

- AVCC

  AVCC is the supply voltage pin for Port A and the A/D Converter. It should be externally connected to VCC, even if the ADC is not used. If the ADC is used, it should be connected to VCC through a low-pass filter.

- AREF

  AREF is the analog reference pin for the A/D Converter

2.2 Traditional Method For Tuning Satellite Dish

Satellite dish receivers have become popular in recent years primarily for use in home television receiving systems. A satellite dish receiver has a dish-shaped receiving antenna. The dish-shaped receiving antenna collects and focuses an incoming transmission beam transmitted by a satellite. The transmission beam carries a signal of interest. for example a television broadcast. Upon striking the dish-shaped antenna. the transmission beam is focused by the parabolic surface of the dish to a center mounted waveguide and receiver. Satellite dish receivers and satellite dish transmitters are highly directional antennas. As a result. they must be precisely aimed at a desired broadcasting satellite for proper operation. Aiming is also referred to as tuning. Generally. the dish is aimed at a pointing. or look. window.

The pointing window is the window in which the satellite is expected to be located. Aiming is generally performed by setting the azimuth and elevation angle of the dish. The pointing window for aiming the dish is very small. The size of the look window is a function of the power of the satellite transmission signal. the shape of the transmis sion footprint. and the manufactured construction tolerances of the dish. To assure proper set up[7].

Software applications are typically used to calculate azimuth and elevation angles for the look window to thousandths of a degree. One such a software application is the AIMIT software from Broadcast Software International. Inc.. 20165 North 67th Avenue. Suite 122A. Glendale. Ariz. 85308 (BSI). High accuracy is required because even slight deviations from the correct alignment of the dish can result in a rapid decrease in signal power received from the arriving transmission beam[7].

Users recognize the decrease in the received signal power as a significant reduction in television reception quality. Television satellites are generally placed in geosynchronous orbits. The geo-synchronous satellite orbit is approximately 23.000 miles above the equator. As a result. geo-synchronous satellites are virtually impossible to see with the naked eye. Even telescopic aides provide little help in locating these satellites visually. Because the sky appears empty to the average person. it is extremely difficult to aim a satellite dish antenna without an aide. Due to this difficulty of finding the satellites. various methods of satellite dish installation have been devised. The current process of aiming the satellite dish antenna is difficult. time-consuming. and costly. Conventional manual aiming techniques require the use of a compass and protractor to measure the azimuth and elevation of the look window[7].

Conventional aiming also involves metering the electronic signal received by the dish. Metering requires moving the dish in small increments and maximizing the received signal until the proper aim to satellite is determined. After the dish has been precisely aimed. it is locked into place. Unfortunately. if the dish is moved. either intentionally or accidentally. it needs to be re-aimed[7].

All conventional metering methods for setting up a dish antenna involve powered-up electronic circuits. One early method involved fully connecting and powering up the satellite dish-based television system. A first installer keep adjusting the satellite dish while a second installer. or assistant. observed the television reception. The first installer adjusted the satellite dish until the second installer indicated that the television picture was of satisfactory quality. Requiring two installers is costly and inefficient. Thus.

methods for installation requiring only one installer were developed. One conventional single-installer method involves an electronic cable attached to a fully operational receiver station carrying a signal back to a meter attached to a satellite dish. The dish installer observes a signal strength meter at the dish. The signal strength meter measures the signal strength of the received signal. The installer adjusts the satellite dish antenna until the meter indicates that the received signal strength is at its greatest No assistant is required. Often. the installer must perform a systematic sweep across the look window to precisely aim the dish. After aiming. the signal cable and the meter on the dish are no longer needed. The entire dish-based television system needs to be fully powered and operational for the setup to succeed. A second conventional one-installer method of metering uses a small LED indicator on the back of the dish to indicate window until the LED lights up. Initially. acquiring the desired signal however. poses a considerable problem[7].

2.3 Related Works

In[7] Richard A. Pauli present invention to solve the problems associated with aiming a directional antenna by using a shadow cast by the sun to simplify antenna aiming. To aim a directional antenna. a user obtains setting information for a calibrated adjustable gnomon (CAG). The setting information indicates the proper settings for the CAG. The user then adjusts the CAG according to the setting information. After the CAG has been properly set. the user aligns the directional antenna by maneuvering it such that a shadow cast by the CAG substantially coincides with a predetermined target co-located with the antenna.
the study in[8]present that a receiver connected to the satellite dish antenna receives signals from an electronic compass for generating a magnetic direction signal. The approximate latitude and longitude values of the parked vehicle are displayed and the user of the system manually selects the latitude and longitude coordinates corresponding to the parked

vehicle location. The receiver determines an initial search position for the satellite dish antenna based upon the magnetic reading and the entered latitude and longitude values. The satellite dish antenna is moved from an unstowed position to an initial search position. The satellite dish antenna is then moved in a first rectangular spiral search pattern to obtain a rough-tune position corresponding to the detection of a signal peak for a selected audio sub carrier frequency in a selected channel of a target satellite. The frequency selected is not present in corresponding selected channels of satellites near the target satellite. A fine-tune search is then per formed and the method calculates all the azimuth and elevation positions of all remaining satellites.
Paul R. Anderson, present A method and device for aligning a satellite receiver antenna with a broadcast satellite is disclosed herein. The device includes a receiver for measuring a signal strength from the satellite and issuing commands based on the measurement.a receiver antenna capable of automatically changing its alignment. and a rough alignment indicator located remotely from the receiver for Signalling when the antenna is Pointed sufficiently toward the satellite allow the receiver to maximize the signal strength by aligning the antenna with the satellite via commands from the receiver. The method includes placing the receiver antenna on a stable surface manually pointing the antenna in the direction of the satellite until an indicator signals that the antenna is preliminarily aligned .fixing the receiver antenna to the stable surface and activating a device remote from the antenna to automatically perform final alignment of the antenna with the satellite[9].

the study in[10] provides an apparatus for aligning an antenna. The apparatus includes means for detecting a received signal strength of a signal received at the antenna. Coupled to the detecting means are means for generating a display signal indicative of the received signal strength. The means for generating is configured to provide a first display signal when the received signal strength is in first state and to provide a second display signal when the received signal strength is in second state. Coupled to the means for generating the display signal are means for displaying the display signal. The means for displaying are capable of responding to both the first display signal and the second display signal. The first display signal may comprise a signal having a frequency proportional to the received signal strength. The second display signal may comprise a signal having a frequency proportional to the inverse of a difference between a maximum received signal strength and a current received signal strength.

The study in [11] provides a method and apparatus for adjusting the position of an antenna to improve reception at a television includes a signal generator Which measures the signal strength received by the antenna. The signal generator sends a low frequency coded signal to a display visible to a person who is adjusting the antenna. The display provides a quantitative indication of the Signal strength to the installer of the antenna, allowing precise adjustments to be made in accordance With the displayed value. The signal generator provides the coded signal to the display via the same cable used to carry the received signals from the antenna to a receiver.

The study in [12] provides a design of control system of a Satellite Dish Antenna Positioning System using stepper motors. The system's software use longitude, latitude of the dish position (antenna site) and the satellite longitude as an input data. The software makes different calculations to transform this data to digits. The digits are then transformed to signals and fed to the stepper motors drivers to move the antenna adjusting azimuth, elevation and polarization angles to the intended satellite.

The study in [13] provides automation for the key steps involved in the manual maneuvering of an antenna dish. Based on procedures for the manual maneuvering a satellite dish. this work uses a gps antenna to monitor the spatial location, and a digital receiver, which provides the value for the carrier-to-noise ratio, C/N. The main focus of this work was to design and develop in Java, a Control System Antenna Maneuvering that can process the information of the spatial position of the antenna, generating a reference signal for a servo capable of processing the C/N and making a fine adjustment of the position of the antenna in order to improve signal reception. The user can select the desired satellite and monitor the process of automatic annotation, through a set of user-friendly graphical interfaces.

the study in [14] provides micro-controller based wireless automatic antenna positioning system.in this study the source of signal is simulated by an Infrared (IR) source. And a corresponding IR receiver is used for detecting the signal. The receiver part includes one monostable that improves the stability of the system, against the transient interruption and momentary absence of the signal. The controller circuit is a Micro-controller 8051. This controller mainly searches the availability of the signal, whenever the signal is found absent at the receiver. The controller drives the DC motor to rotate and this rotation goes on till the receiver found the signal. The controller provides necessary signal to the motor driver on which the antenna is mounted. The driver circuit provides adequate current and necessary voltage level to drive the motor in turn to move the antenna. The interfacing between the transmitter unit and the receiver unit is done through DTMF Encoder and Decoder which gives the coding and decoding scheme that is flexible signaling scheme with high reliability just as that used in telephone communication technology. The transmitter used here employs FM technology which eliminates possibility of any distortion. The decoded massage at the receiver unit is fed to the controller unit which after requisite signal processing displays the position of the antenna by exhibiting the degree of rotation of the antenna with respect to a certain reference point.

The study in [15] provides An automatic control system for controlling the operation of a sliding door system employs an electric motor for driving the sliding door system. An encoder is mounted to the shaft of the motor for generating signals which are decoded to detect the operational position of the sliding door system. A clock paced sequential logic circuit produces speed and directions signals in accordance with the detected operational position to control the speed and direction of the electric motor. Means are provided for recording the last stop position and slowing the sliding door system prior to reaching the last stop position. Safety means are provided to de-energize the motor in the event of malfunction of the motor speed control. The system also includes a reduced opening stop feature and a means for automatically establishing a sliding door reference position.

The study in [16] provides a method of positioning a part includes the steps of reciprocatingly moving a part between two end positions by a drive, generating a control signal for the drive upon reaching the end positions, stopping the drive or changing a drive direction of the drive upon receipt of the control signal; detecting a position of the drive after a first reaching of at least one of the end positions by the part, storing the detected position of the drive, and during further approaches of the end positions by the part, stopping the drive or changing the drive direction before reaching the end positions. After a selectable number of approaches of the part to at least one of the end positions the drive is stopped only when the end position is reached and the position of the drive is detected and stored once again.

2.4 Contribution

In view of the previous section that all thesis submitted tried to solve the problem of satellite antenna alignment process but some of them still need manual procedure and some of them need a complicated electronic circuits and software.this work tried as much as possible to avoid manual procedure and using less electronic component using DC motor with feedback mechanism ,MCU,signal detector.

2.5 Chapter Summary

This chapter explain satellite communications system and some background knowledge deals with basic concept and parameters in satellite communications.This chapter also surveys the previous studies on this subject, so that deals with the method and techniques used by each researcher and the steps followed by the discussion of the findings and then mentioned shortcomings in this way until it is avoided in the proposed method.

Chapter Three

SYSTEM DESIGN

Chapter Three

SYSTEM DESIGN

this chapter will focus on the discussion on the project design and implementation method,hardware components will be introduced as well .This control system consist of two main parts hardware part and software part. The hardware part consist of a parabolic antenna equipped with two dc motor (motorized antenna) one for(up_down) motion (elevation) and the other one for left right motion (azimuth) , micro-controller unit (mcu) (atmega32), dc motor driver and signal detector .The software part used in this work is BASCOM AVR and proteus software for simulating the system.

3.1 System block diagram

This proposed system allows the user of digital satelite TV to align their parabolic antenna easily , quickly and without need for professional installer.The block diagram of the proposed system consists of six blocks actuators,parabolic antenna ,motor feedback system, controller (MCU) ,signal detector. shown in figure 3.1.

3.2 System Overview

The main and extremely important component in this system is mcu atmega32 avr. Which acts as a brain for this system . This controller will get some input signals from input devices such as switches , sensors. In this project there are two switches one of them assigned for setting or searching process and the other assigned for satellite aligning . Then according to these inputs controller (mcu) (atmega32) will take a decision . this decision will be :

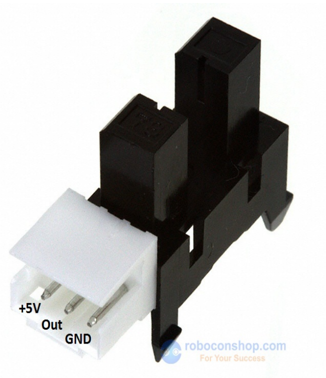
- Moving the up_down motor (elevation motor) and left_right motor (azimuth motor) to form pulses sweep pattern during searching process or scanning process.

- Moving the elevation motor and azimuth motor directly toward the position of the required satellite.

(a) limit switch

(b) ATMEGA32

(c) relays



(d) optocoupler

(e) dc motor

(f) uln2003

Figure 3.2: main system components

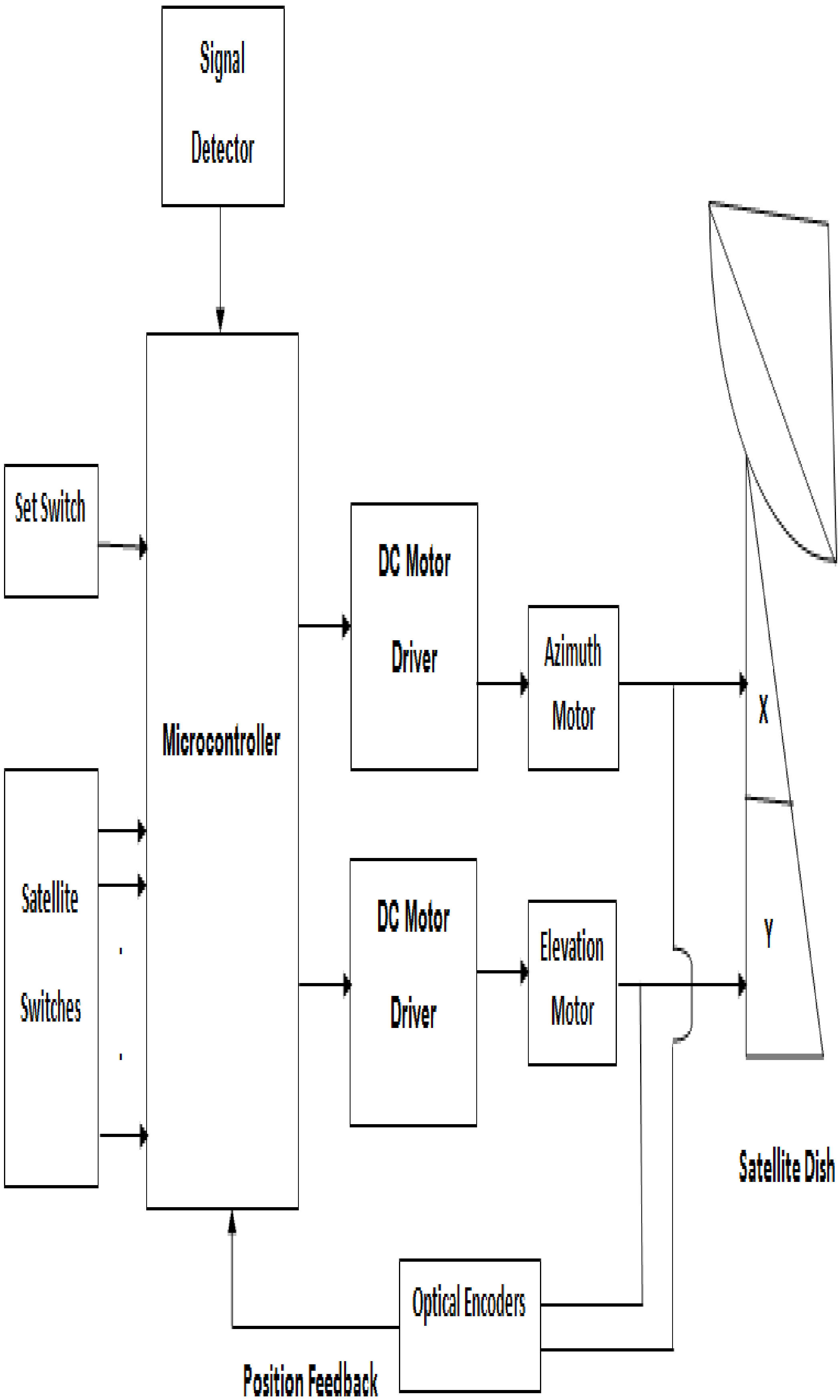


Figure 3.1: system block diagram

3.3 Component of the System

Figure 3.2 shows the main system component and it can be divided into two components hardware and software.

3.3.0.1 Use of Atmega32 Microcontroller in the System

In this work Atmega32 Microcontroller is used for controlling the operation of the system according to specific program written in it's memory.input pins of this microcontroller are connected to input devices such as signal detector, switches, limit switches and optocouplers.outputs pins of this MCU connected to DC motor driver.

3.3.1 Signal Detector

A satellite finder (or sat finder) is a satellite signal meter used to accurately point satellite dishes at communications satellites in geostationary orbit[17].
Satellite Finder Signal Meter displays signal strength, according to dish position.
The Satellite Finder is installed between the satellite dish and receiver. Satellite Signal Meter is powered by satellite receiver so it does not need additional power supply.

3.3.1.1 Satellite Finder Features

- 75 ohm BS type F outlet
- Inside installed micro lamp and buzzer.
- Input frequency: 950 - 2250MHz.
- Min. input level: -40dBm.

Figure 3.3: Satellite Finder

- Max. input level: -10dBm.
- Power supply: 13 - 18V DC.

3.3.1.2 Use of Signal Detector in the System

In this work signal detector is modified to be interfaced with MCU .in normal signal detector output signal is current signal. Then in order to fed this signal to MCU it must be converted into voltage this done by inserting 10K OHM resistor at the output of signal detector.Then the voltage across this resistor fed to MCUafter this modification the output range of signal detector became in the range of 0v to 5v .This range is suitable for MCU.

3.3.2 DC Motor

In a DC motor, an armature rotates inside a magnetic field. Basic working principle of DC motor is based on the fact that whenever a current carrying conductor is placed inside a magnetic field, there will be mechanical force experienced by that conductor. All kinds of DC motors work in this principle only. Hence for constructing a DC motor it is essential to establish a magnetic field. The magnetic field is obviously established by means of magnet. The magnet can by any types i.e. it may be electromagnet or it can be permanent magnet. When permanent magnet is used to create magnetic field in a DC motor, the motor is referred as permanent magnet DC motor or PMDC motor.

3.3.2.1 Construction of Permanent Magnet DC Motor or (PMDC)

Rotor: The rotating part of the motor.
Stator: The stationary part of the motor.
Field system: The part of the motor which provides the magnetic flux needed for creating a torque. the field system consists of two permanent magnets and an iron housing, forming a part of the stator.
Armature: The part of the motor which carries the current that interacts with the field flux to create the torque. In the motor the rotor is referred to as the armature since it has coils wound around it. These coils serve to transfer the current from the brushes and commutator to the rotor[18].
Brushes: The part of the circuit through which the electrical current is supplied to the armature from a power supply. Brushes are made of graphite or precious metal. A DC motor has one or more pairs of brushes. one brush is connected to the positive terminal of the power supply, and the other to the negative[18].
Commutator: The part which is in contact with the brushes. The current is properly distributed in the armature coils by means of the brushes and commutator[18].

3.3.2.2 Working Principle of Permanent Magnet DC Motor

the working principle of PMDC motor is just similar to the general working principle of DC motor. That is when a carrying conductor comes inside a magnetic field, a mechanical force will be experienced by the conductor and the direction of this force is governed by Fleming's left hand rule. As in a permanent magnet DC motor, the armature is placed inside the magnetic field of permanent magnet; the armature rotates in the direction of the generated force.Each conductor of the armature experiences a force and the compilation of those forces produces a torque, which tends to rotate the armature.

3.3.2.3 Advantages of Permanent Magnet DC Motor

PMDC motor have some advantages over other types of DC motors. They are :

1. need of field excitation arrangement.
2. No input power in consumed for excitation which improve efficiency of DC motor.
3. No field coil hence space for field coil is saved which reduces the overall size of the motor.
4. Cheaper and economical for fractional kW rated applications.

3.3.2.4 Disadvantages of Permanent Magnet DC Motor

1. In this case, the armature reaction of DC motor cannot be compensated hence the magnetic strength of the field may get weak due to demagnetizing effect armature reaction.
2. There is also a chance of getting the poles permanently demagnetized (partial) due to excessive armature current during starting, reversal and overloading condition of the motor.
3. Another major disadvantage of PMDC motor is that, the field in the air gap is fixed and limited and it cannot be controlled externally. Therefore, very efficient speed control of DC motor in this type of motor is difficult.

3.3.2.5 Use of PMDC Motors In The System

In this work there are two PMDC motors and they are used for moving antenna in two dimensions (horizontal movement,vertical movement).

- horizontal movement to set azimuth angle of parabolic antenna.
- vertical movement to set the elevation angle of antenna.

these two motors are controlled by MCU through motor drivers.

3.3.3 ULN2003

ULN2003 is a high-voltage, high-current Darlington transistor arrays. Each consists of seven npn Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA. The Darlington pairs can be paralleled for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers.
The ULN2003A and ULN2003A have a 2.7kilo-ohm series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices[19].

3.3.3.1 ULN2003 main feature

- 500-mA-Rated Collector Current (Single Output)
- High-Voltage Outputs . . . 50 V
- Output Clamp Diodes
- Inputs Compatible With Various Types of Logic
- Relay-Driver Applications

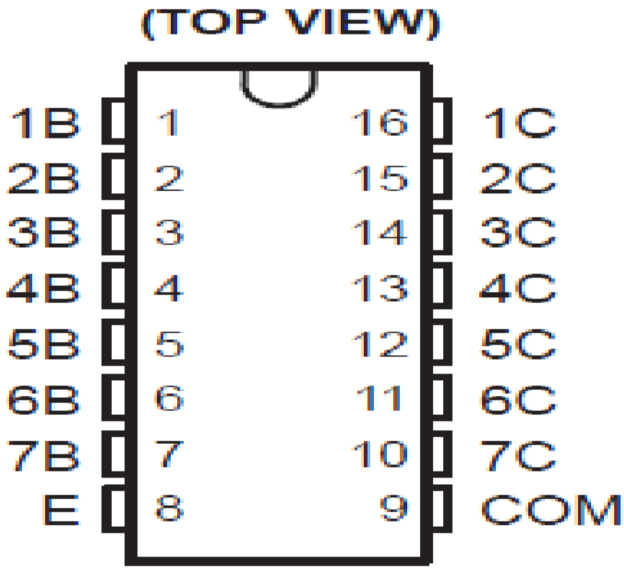


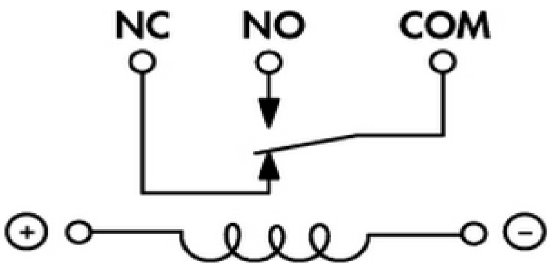
Figure 3.4: ULN2003 IC

3.3.4 Relays

A relay is defined as a device in which predefined changes occur rapidly in single or multiple electrical output circuits when the control electrical input circuit fulfills a certain condition. An electromagnetic relay is defined as a relay that operates or resets due to electromagnetic effects caused by a current flowing in the coil which makes up the control input circuit. one important function is that the input and output circuits are electrically insulated from each other so that the relay can transfer signal and control output signals .this function means that the relay can be used to make circuits with particular features which are not possible with transistorized sequence circuits or load control circuits .in particular the relay can provide safety ,noise cutting ,bypass-circuit prevention , interlock, and other functions[20].

3.3.4.1 Relay Operation

The contact of a relay switch when avoltage or current is applied to the coil . despite this simple operation relay can be used to for wide variety of purposes amplification ,convertion functions , transfer, interlock functions[20].



(a) RELAY CONTACTS

(b) 5V RELAY

3.3.4.2 Advantages

- Electrical Isolation: No electrical connection between coil and contact sides.
- High Voltage Current (on contact side)

3.3.4.3 Disadvantages

- Power Lost in Coil
- Size: Big and bulky.
- SLOW!
- Expensive

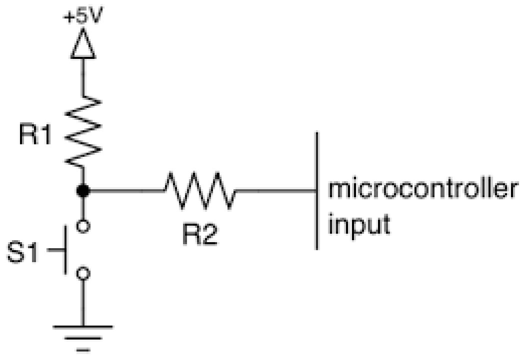
3.3.4.4 Use of Relays and ULN2003 IC In The System

In this work both ULN2003 IC and relays are used as a drivers for dc motor (az-motor ,ELE-motor) .these drivers are controlled by MCU.
to move antenna (up-down)or(left-right) the motor must be driven in clockwise and anti-clockwise direction .this done by the circuit below which consist of two relays.

3.3.5 Push Button

Push button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. Buttons are most often biased switches.

(a) push button



(b) biasing circuit

3.3.5.1 Use of Push Button in the System

In this work push buttons are used for starting of setting or scan process (searching button) to search for required satellite and then save it's position in the EEPROM of MCU.The other button is used for aligning antenna to saved satellites(set specific satellite).

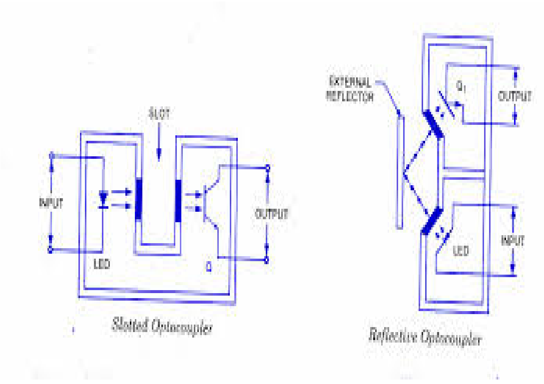
3.3.6 Optocoupler

The GK106 (Slot Optical Switch) is a gallium arsenide infrared emitting diode which is coupled with a silicon photo transistor in a plastic housing. The packaging system is designed to optimizes the mechanical resolution, coupling efficiency, and insulates ambient light. The slot in the housing a provides a means of interrupting the signal with printer, scanner, copier, or other opaque material, switching the output from an " ON" to" OFF" state.

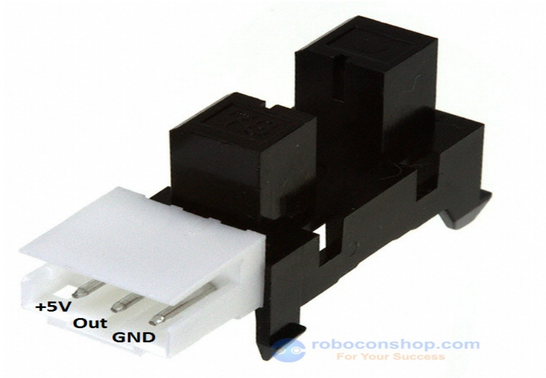
3.3.6.1 Optocouplers Features

- Wide gap between light emitter and detector(4.0mm)
- High sensing accuracy

- mounting type package



(a) optocoupler circuit



(b) optocoupler

3.3.6.2 Use of Optocouplers in the System

In this work there are two optocouplers one for each motor and they are used in order to get feedback from motors .When the optocoupler slot interrupted the output is 5V and when the not interrupted the output is 0V.The interruption mechanism here done by using metal disk as in the figure 3.10 .this disk is coupled to motor shaft as shown in the figure 3.10 .

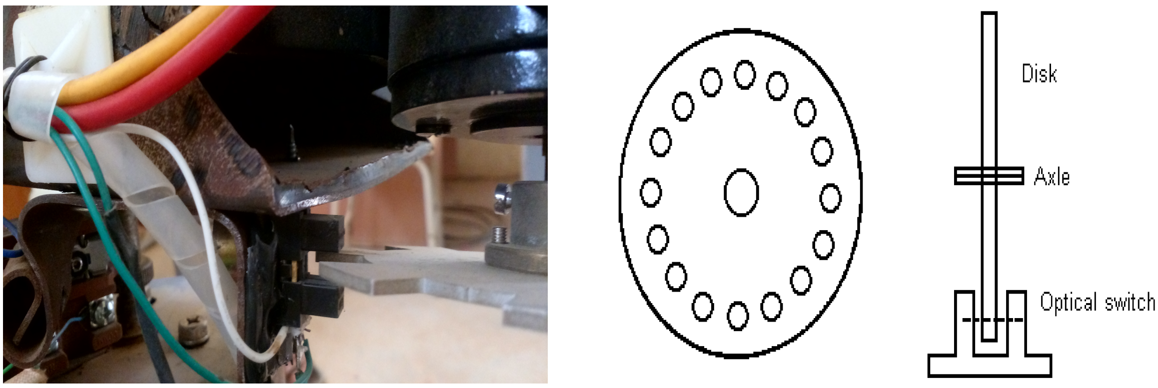


Figure 3.8: metal disk

3.3.7 Low Noise Block Converter

LNB is the heart of the satellite antenna. Basically, it's a cavity resonator which receives satellite signals reflected from the antenna focus and process the signals. Similar to the pipe organ that converts the energy into an electrical signal transmissions. An electronic switch is added to amplify the

signal before it is sent to the coax cable and turn it into a lower frequency to reduce signal loss in the cable.
LNB types used today use the same technology, the key differentiating factor is the noise figure has been reduced to the lowest possible value in theory of 0.3 dB in most models.

3.3.8 Power Supply

A power supply is an electronic device that supplies electric energy to an electrical load. The primary function of a power supply is to convert one form of electrical energy to another.Every power supply must obtain the energy it supplies to its load.
All power supplies have a power input, which receives energy from the energy source, and a power output that delivers energy to the load.
in this work there are two power supply 5v power supply and 12v power supply .5v power supply is used to power MCU circuit ,12v power supply is used to power dc motor .

3.3.9 Worm and Gear

Worm-and-gear sets are a simple and compact way to achieve a high torque, low speed gear ratio. For example, helical gears are normally limited to gear ratios of less than 10:1 while worm-and-gear sets vary from 10:1 to 500:1. A disadvantage is the potential for considerable sliding action, leading to low efficiency[21].A worm gear is a species of helical gear, but its helix angle is usually somewhat large (close to 90 degrees) and its body is usually fairly long in the axial direction. These attributes give it screw like qualities. The distinction between a worm and a helical gear is that at least one tooth persists for a full rotation around the helix. If this occurs, it is a 'worm'; if not, it is a 'helical gear'. A worm may have as few as one tooth. If that tooth persists for several turns around the helix, the worm appears, superficially, to have more than one tooth, but what one in fact sees is the same tooth reappearing at intervals along the length of the worm.

The usual screw nomenclature applies: a one-toothed worm is called single thread or single start; a worm with more than one tooth is called multiple thread or multiple start. The helix angle of a worm is not usually specified. Instead, the lead angle, which is equal to 90 degrees minus the helix angle, is given.

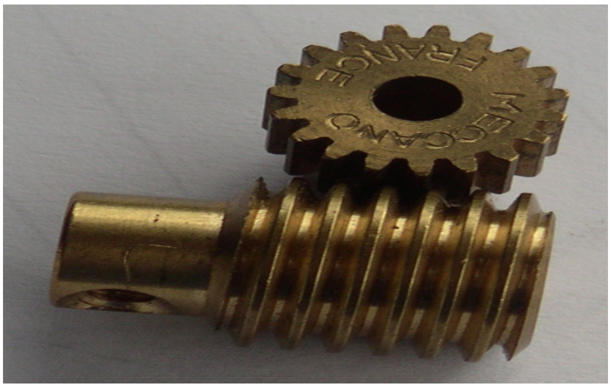


Figure 3.9: worm and gear

In a worm-and-gear set, the worm can always drive the gear. However, if the gear attempts to drive the worm, it may or may not succeed. Particularly if the lead angle is small, the gear's teeth may simply lock against the worm's teeth, because the force component circumferential to the worm is not sufficient to overcome friction.

Worm-and-gear sets that do lock are called self locking, which can be used to advantage, as for instance when it is desired to set the position of a mechanism by turning the worm and then have the mechanism hold that position.If the gear in a worm-and-gear set is an ordinary helical gear only a single point of contact is achieved[22].

3.3.9.1 Use of Worm Gear in The System

In this work worm gear used to couple the motors to antenna axial (X,Y) where this gear have the mechanism of holding its position .Which called self locking .This property makes antenna to be locked to specific position after alignment process .

3.4 Simulation Tools

In this work there two software used BASCOM AVR ID and PROTEUS .BASCOM AVR ID is a high-level programming language BASIC for AVR microcontroller development platform. BASCOM-AVR BASIC program is easy and it can be achieved with a simple statement. Another software is PROTEUS ISIS .This program used to simulate the operation and design of the system

3.5 Chapter Summary

This chapter displays the alignment system electronic component and their operation ,the software used in this system, mechanical component.Also provide each component contributions in the system operation .Also displays how these components are connected to each other"elctronic circuit".Also provide the system block diagram and system design.

Chapter Four

RESULTS AND DISCUSSIONS

Chapter Four

Results and Discussion

In the previous chapter, we built up the foundation for the simulation and design by specifying the functions of each component in the system.In this chapter we discuss how to form system design and simulation from those individual components , and share some of our observations during the execution.

4.1 System Flow Chart

The system operation stages can be explained in four processes :

- Reference Position process
  figure 4.1 shows reference or initial positioning process flow chart.This process done by start moving azimuth motor on CW direction .This makes antenna to move right .This moving continue until MCU receive signal from right limit switch .When MCU receive this signal it send stop signal to stop azimuth motor and start moving elevation motor on (CCW)direction .This makes antenna to move down .This movement continue until MCU receive signal from down limit switch .Then after MCU receive this signal it will generate stop signal to stop elevation motor .At this moment antenna is positioned to its reference or initial position .

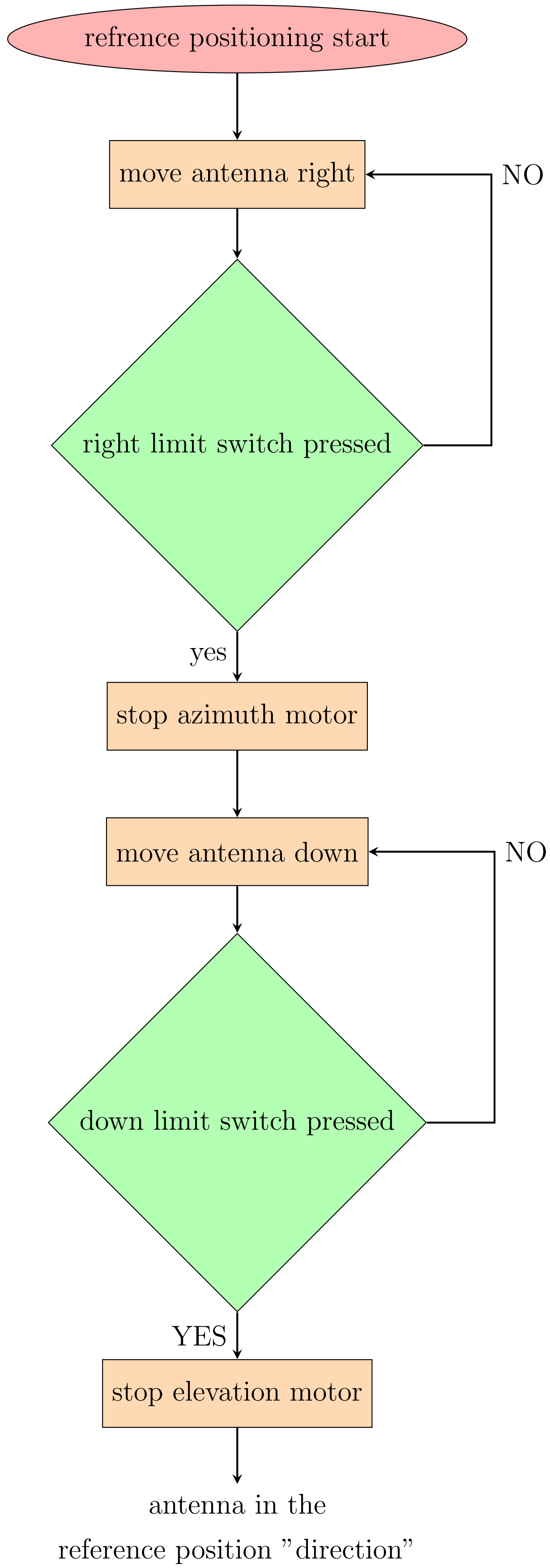


Figure 4.1: reference positioning process

- Scan or Search Process

  Figure 4.2 shows the scan or search process flow chart.This process start after moving antenna to its reference position .Then MCU start moving antenna in spiral pattern .This done by using MCU .This process starts by sending starting signal to elevation motor to move CW direction ,this makes antenna to move up .This movement continue until MCU receives signal from up limit switch .Then MCU generates signal to stop elevation motor and generates signal to operate azimuth motor on CCW direction .This makes antenna to move left ,this signal continue for 200ms .After elapsing of this time (200ms) MCU generates signal to operate elevation motor in CCW direction .This makes antenna to move down .This movement continue until MCU receive signal from down limit switch .Then MCU generates two signals, stop signal to stop elevation motor and start signal to operate azimuth motor in CCW .This makes antenna to move left ,then after 200ms time MCU generates stop signal to stop azimuth motor .At this moment one cycle of spiral pattern is done . This cycle is repeated until detector signal became above threshold value.

- saving process

  Figure 4.3 shows saving process flow chart.This process done only when the signal is above threshold value .in this process antenna return to reference position .This return movement is done in two stages .First stage antenna moved back to its reference azimuth direction and during this return feedback of azimuth motor monitored by MCU dy counting pulses coming from azimuth motor optocoupler .This counting process continue until antenna reach its reference direction of azimuth .Then the final counting number is saved in EEPROM of MCU .Second stage antenna moved back to its reference minimum elevation direction ,during this return feedback of elevation motor monitored by MCU by counting pulses coming from elevation motor optocoupler .This counting process continue until antenna reach its reference minimum direction of elevation .Then the final counting number is saved in EEPROM of MCU.At this moment system save the satellite position in four EEPROM locations ,two locations for azimuth pulses number and the other two locations for elevation pulses number .One EEPROM location is 8 bits .so it can take up to 256.The counters of MCU used to count pulses are counter0 and counter1 .Counter0 is 8 bits counter and counter1 is 16 bits counter .every counter has its own overflow flag .Number of pulses can be above counter capacity ,due to this problem , number of overflow counted .Then to save number of azimuth pulses two locations was used ,one location for saving number of overflow times.other location for saving counter number.Also two locations was used for saving number of elevation pulses.

- Alignment Process

  Figure 4.4 shows alignment process flow chart .In order to do this process set button must be pressed then this process starts by returning antenna to its reference positon (reference azimuth + reference minimum elevation).Then the MCU move antenna to the left by generating signal to make azimuth motor moves CCW direction ,during this movement MCU starts counting azimuth motor pulses .This movement (left movement) continue until current number of AZ pulses equals the saved EEPROM AZ pulses.When this condition met .MCU stop azimuth motor and generating signal to move antenna up by making elevation motor moves CW direction .During up movement MCU start counting the number of elevation motor feedback pulses.This up movement continue until current number of pulses equals the saved EEPROM elevation pulses .When this condition met MCU stop up movement .At this moment antenna is aligned to the required satellite.

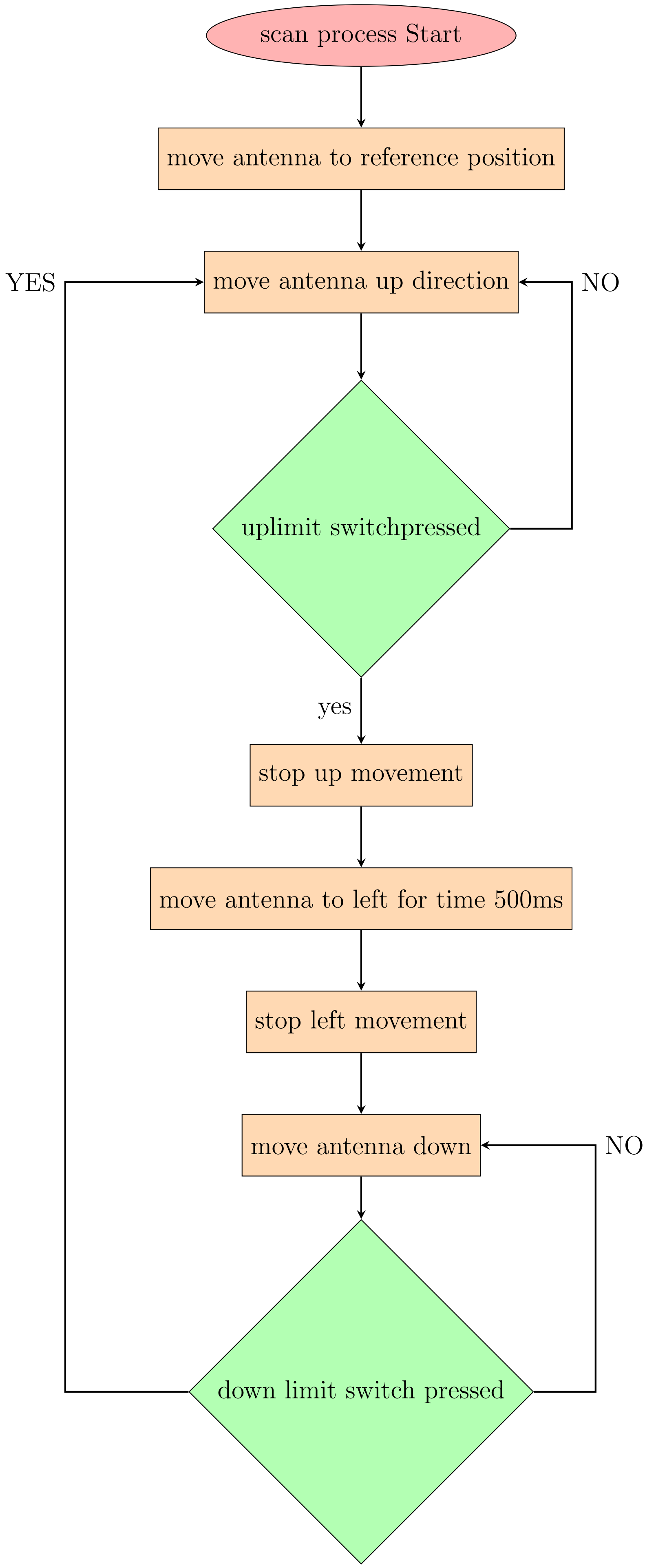


Figure 4.2: scan or search process

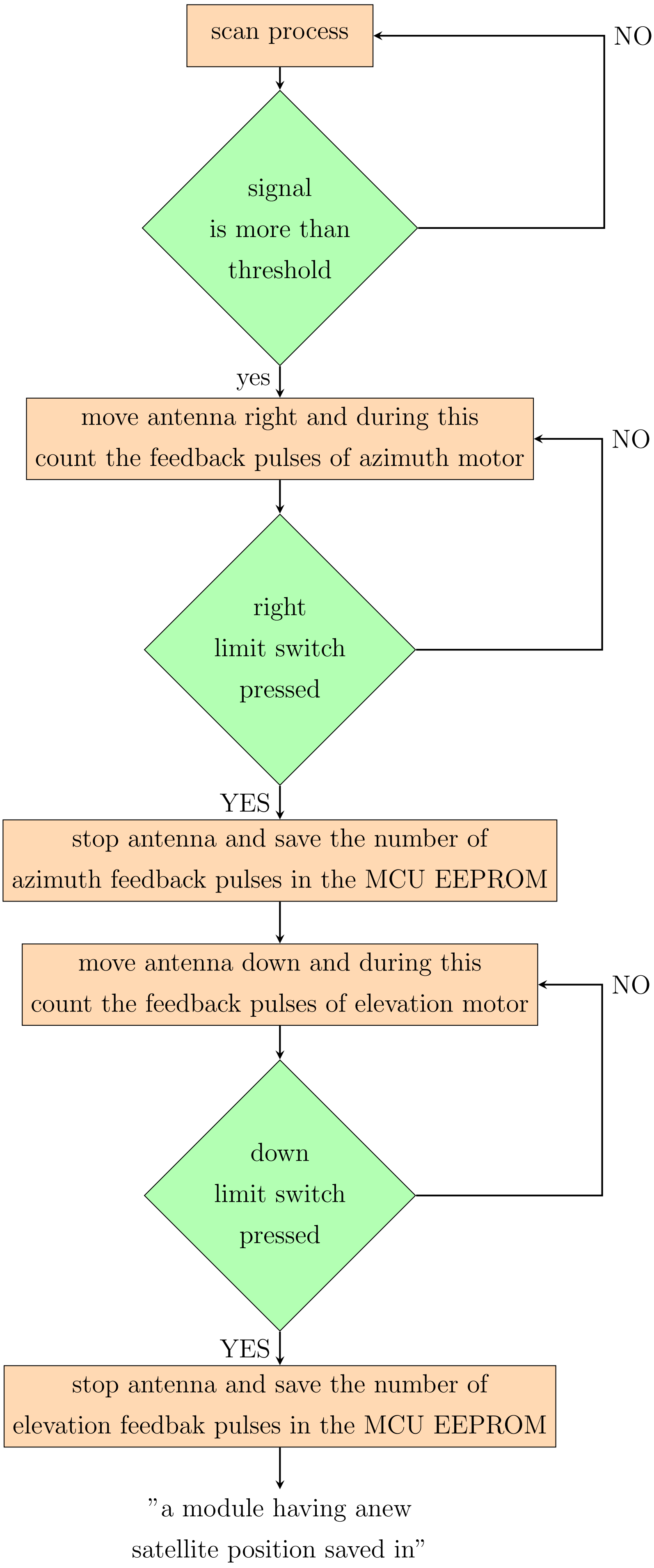


Figure 4.3: saving process

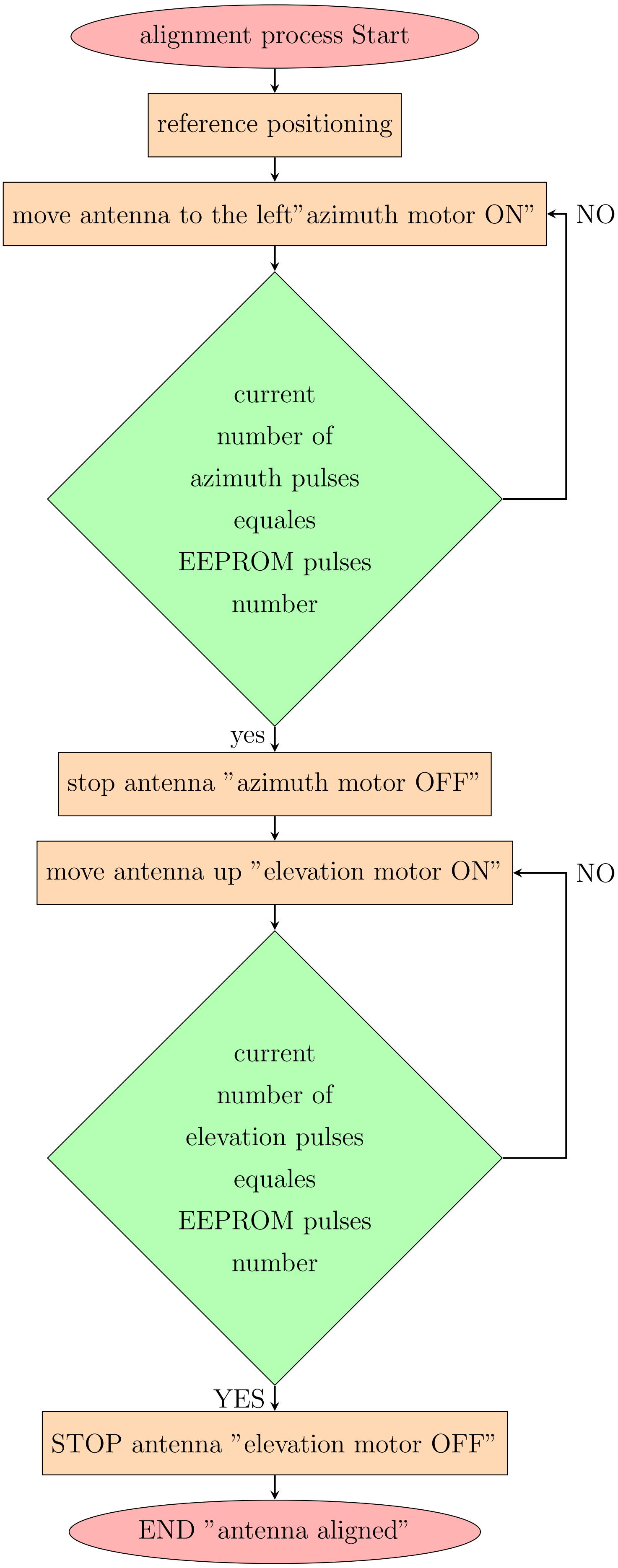


Figure 4.4: alignment stage

4.2 System Simulation

Figure 4.5 shows how components are connected to each other

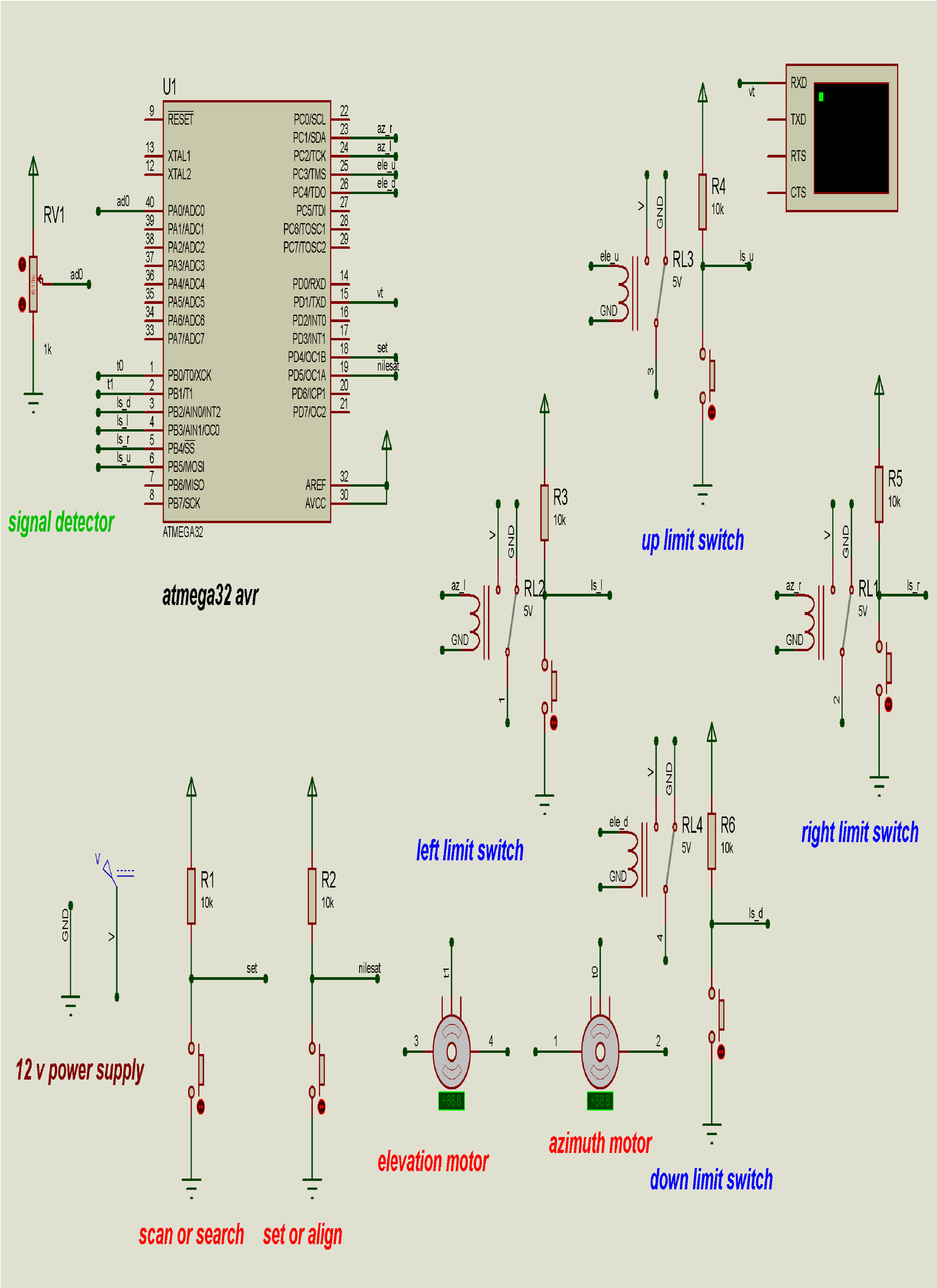


Figure 4.5: system electronic circuit wiring diagram

4.2.1 System Simulation Running

Figure 4.6 shows that antenna need to be aligned since signal level is under threshold .set button is pressed and antenna start scan process by moving antenna to its reference azimuth.

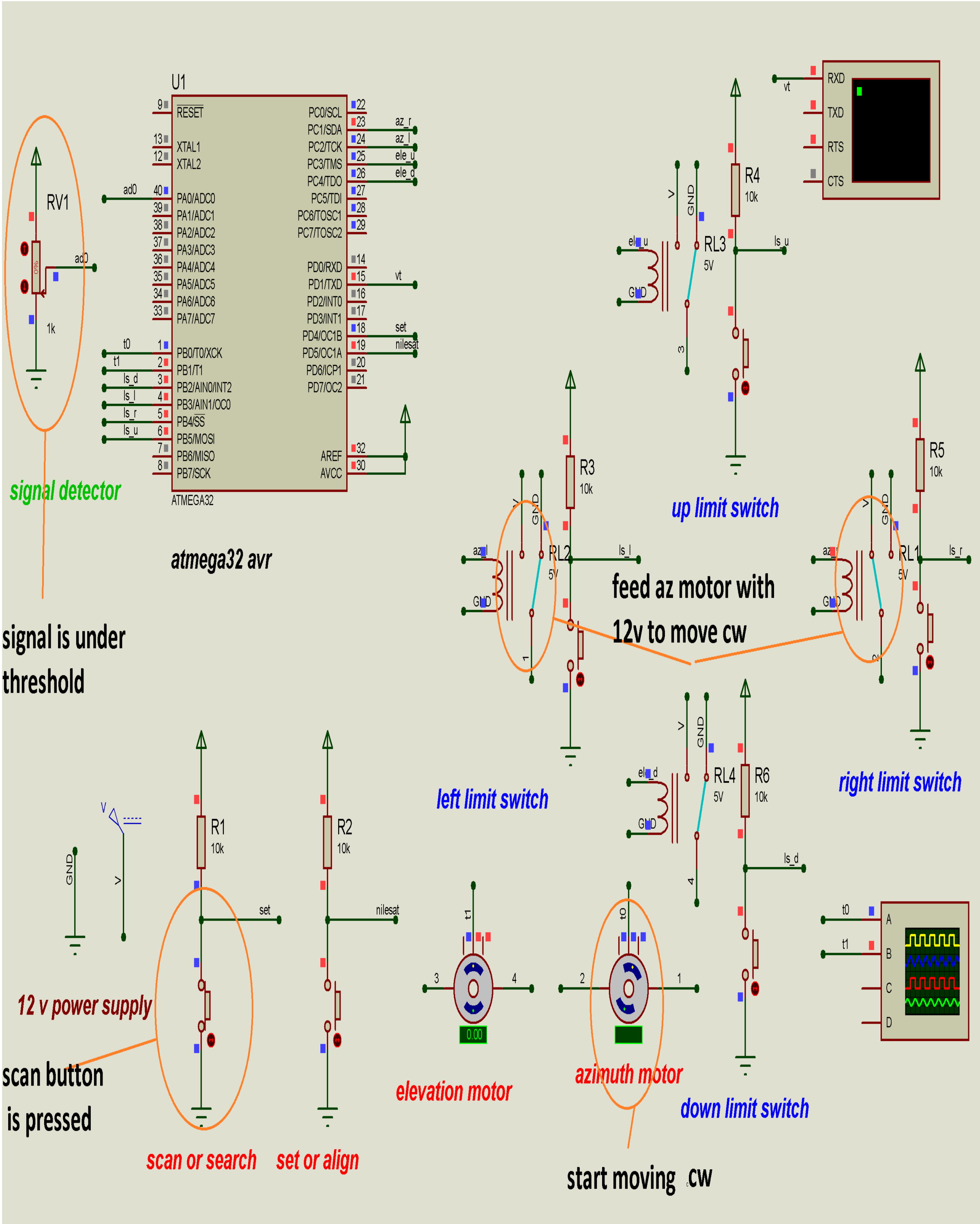


Figure 4.6: reference position process

Figure 4.7 shows that antenna reach its azimuth reference by pressing right limit switch, and then antenna starts to move down toward its minimum elevation angle.

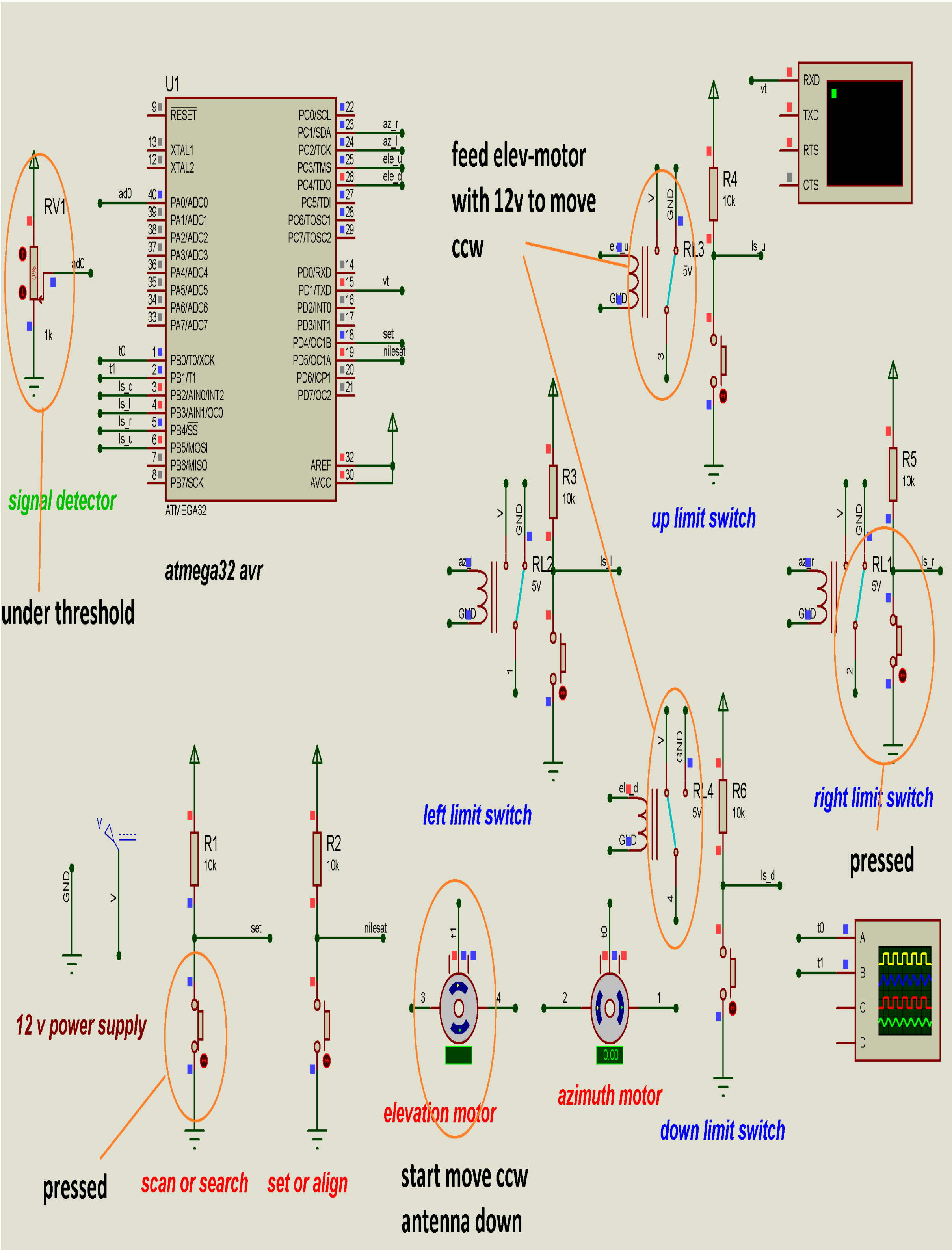


Figure 4.7: reference position process continue

Figure 4.8 shows that antenna reach its reference minimum elevation by pressing down limit switch and start pulses patter movement cycle.

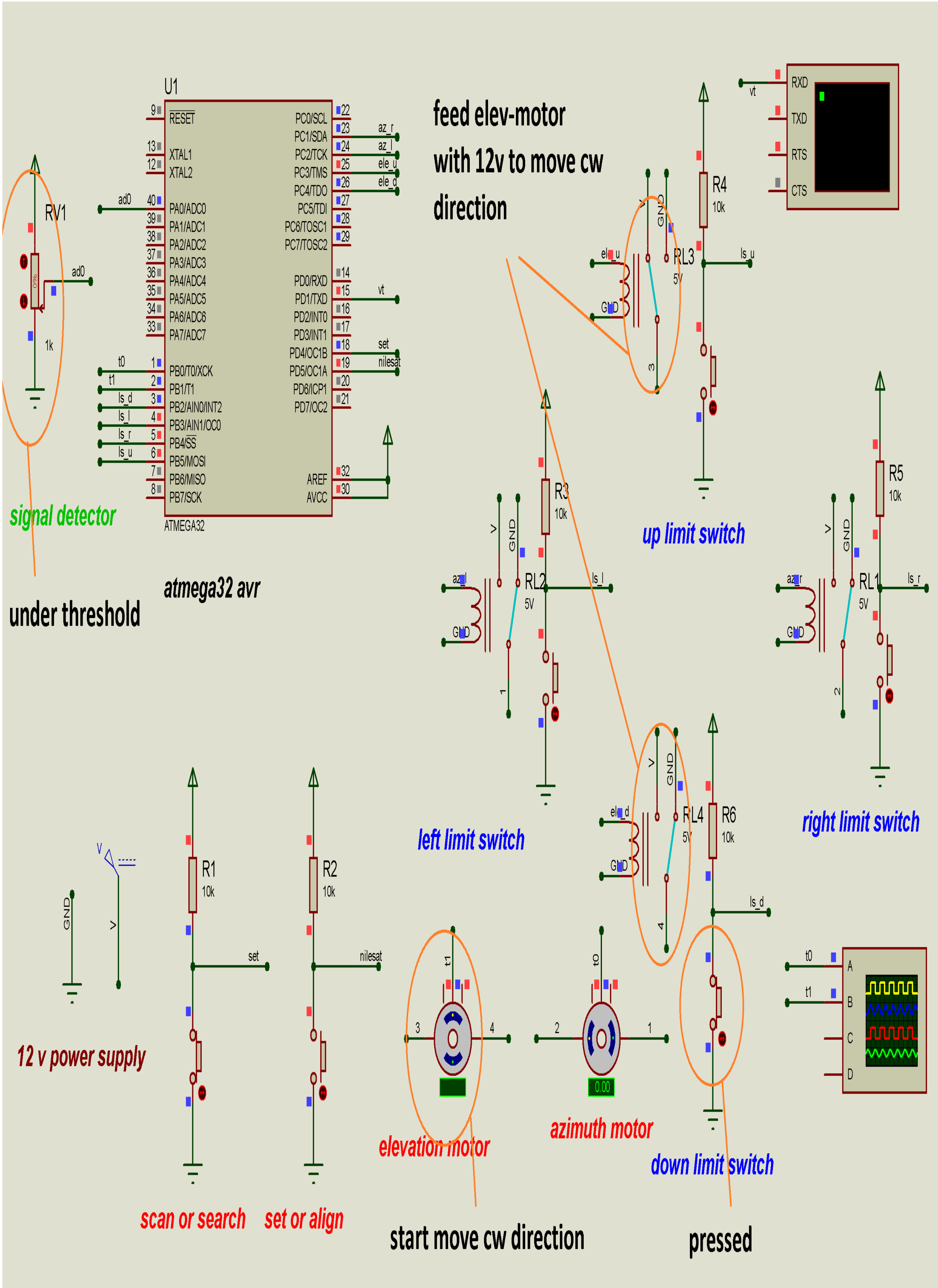


Figure 4.8: reference position process end

Figure 4.9 shows that antenna starts move in pulses pattern movement.

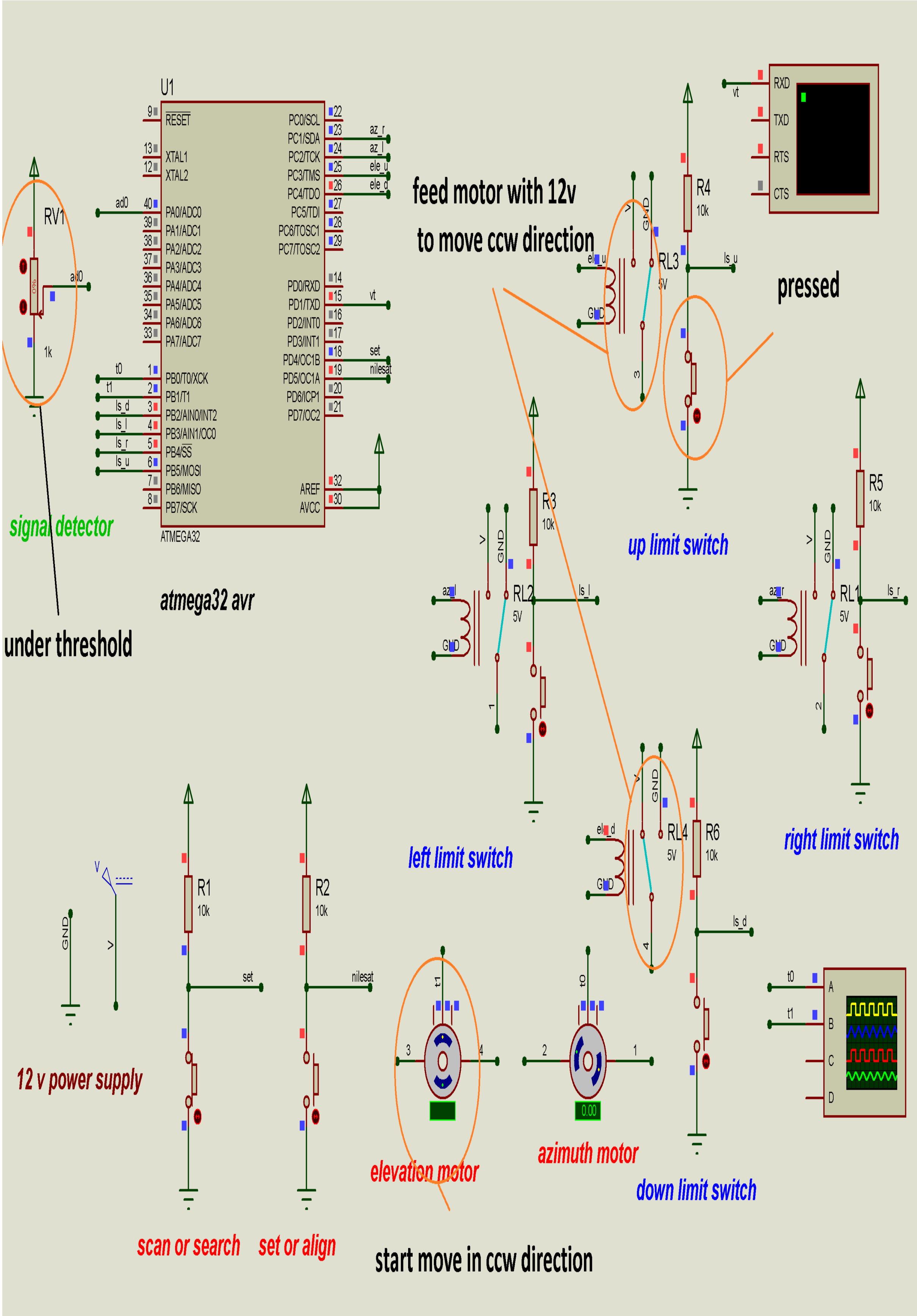


Figure 4.9: start of pulses pattern cycle

Figure 4.10 shows that signal became above threshold value and antenna starts to return to its reference azimuth direction and during this return process,feedback pulses are under counting.

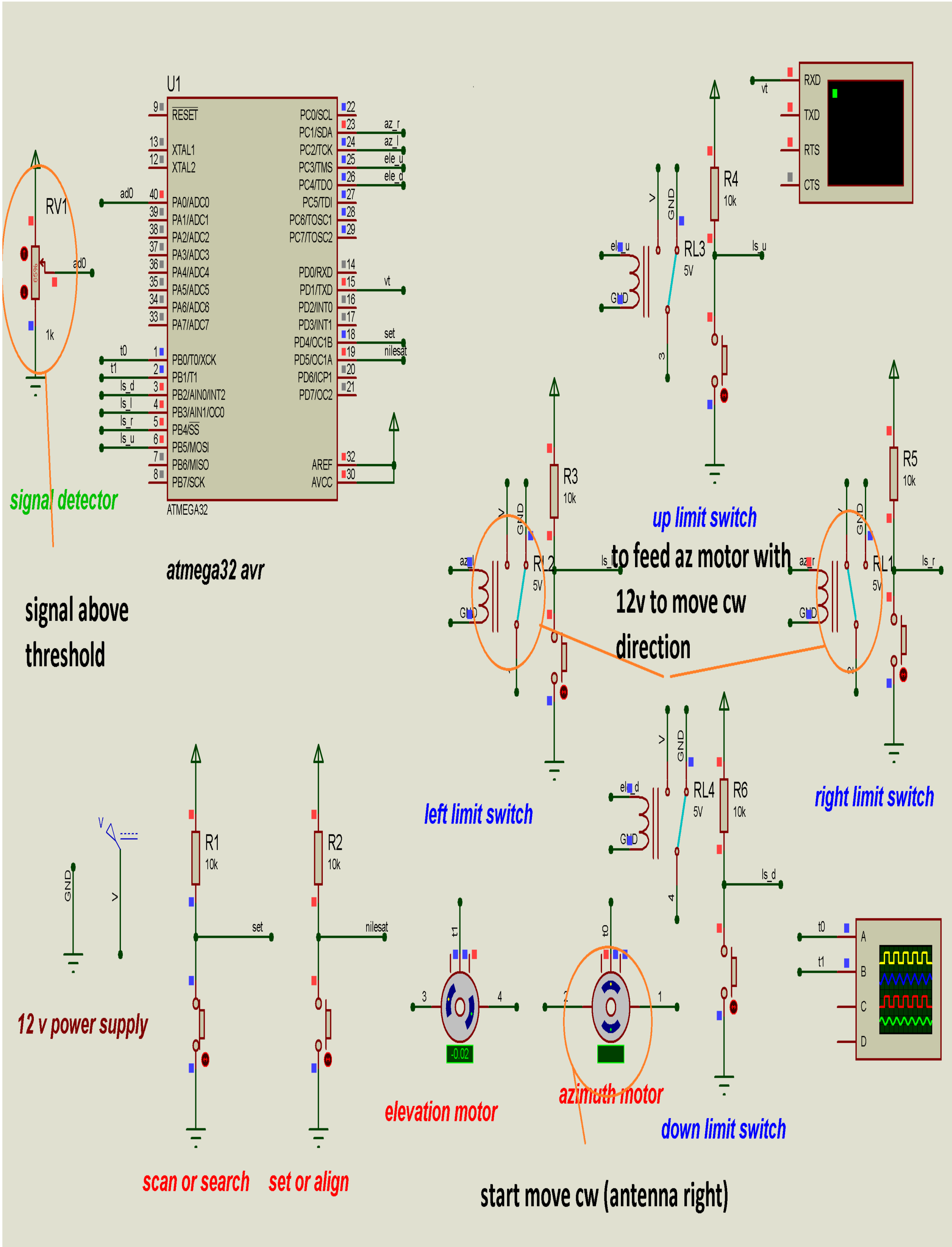


Figure 4.10: End of scan process and start saving process

Figure 4.11 shows that when antenna reach its reference azimuth by pressing right limit switch.Antenna starts to return to its minimum elevation angle by pressing down limit switch and during that feedback pulses are under counting.

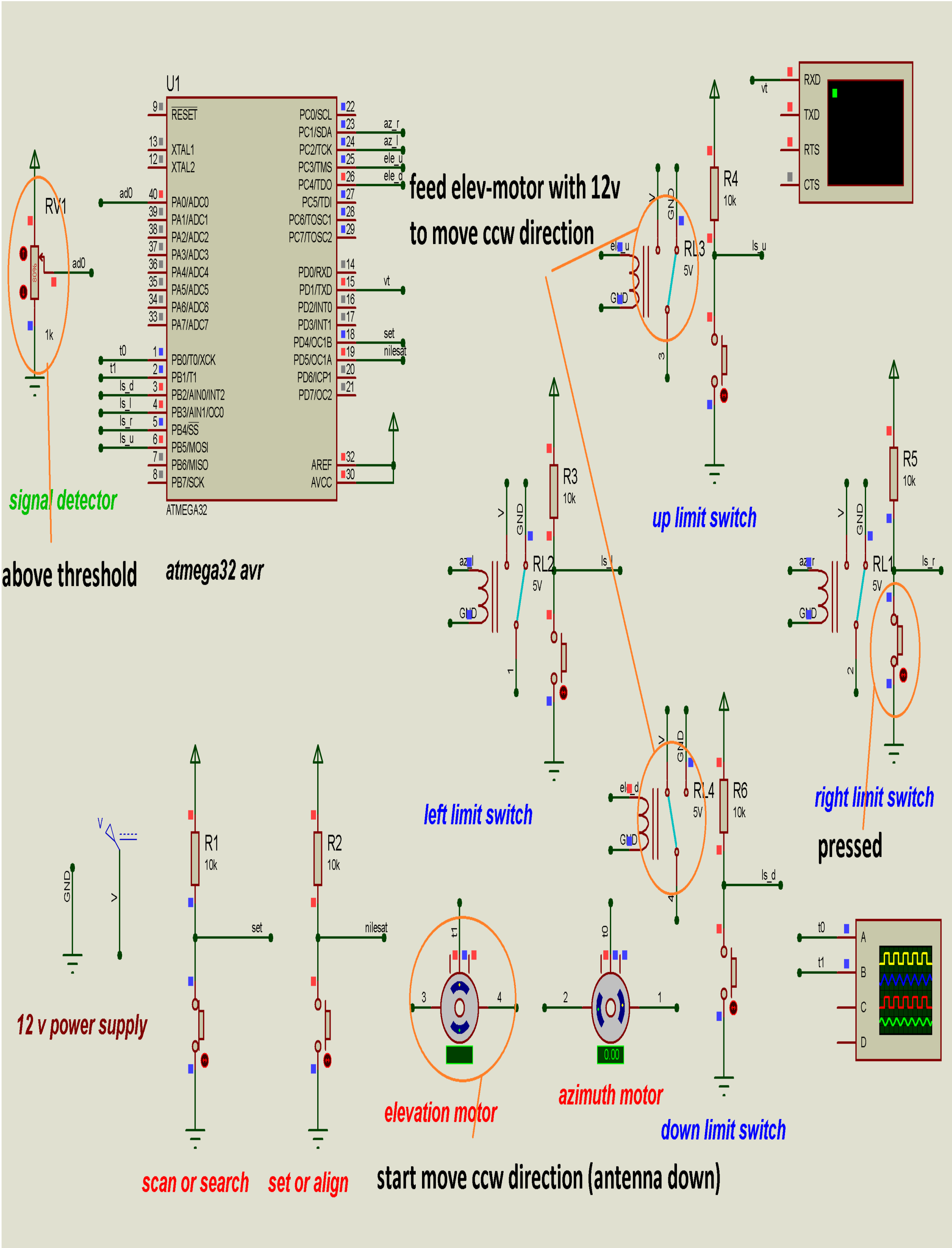


Figure 4.11: saving process continue

Figure 4.12 shows end of saving process by pressing down limit switch .Antenna at reference with position of satellite saved in its EEPROM.

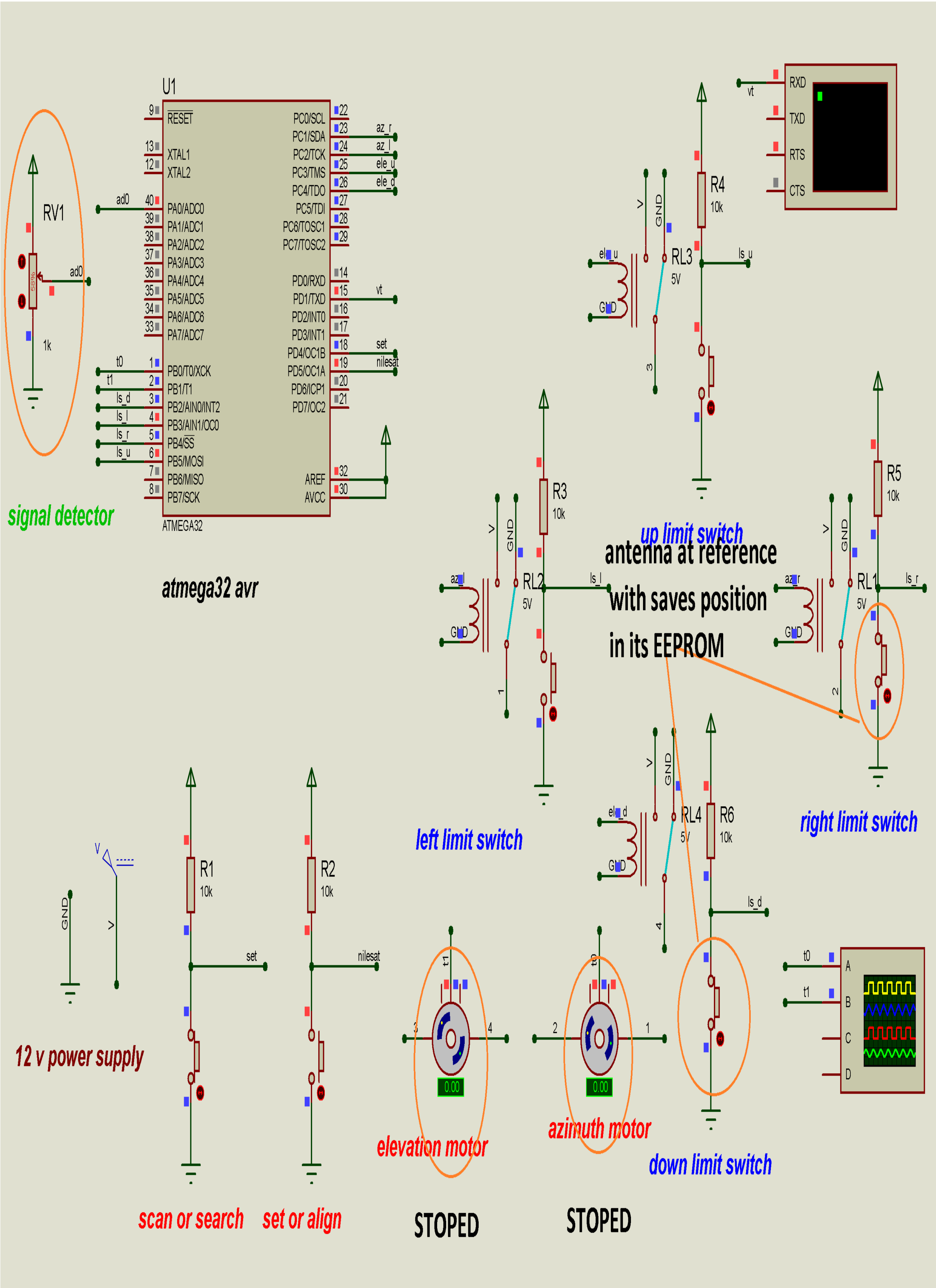
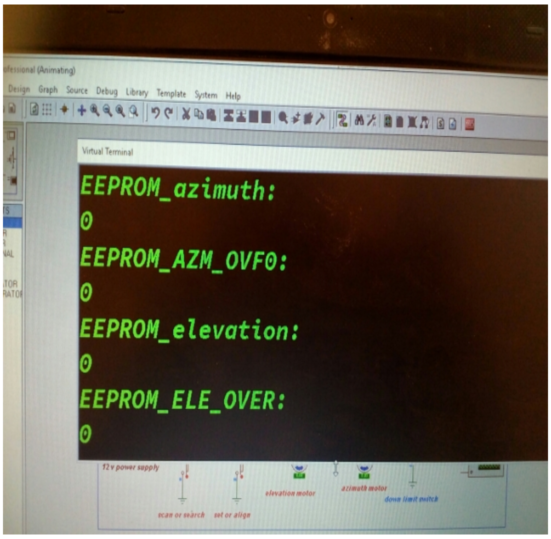
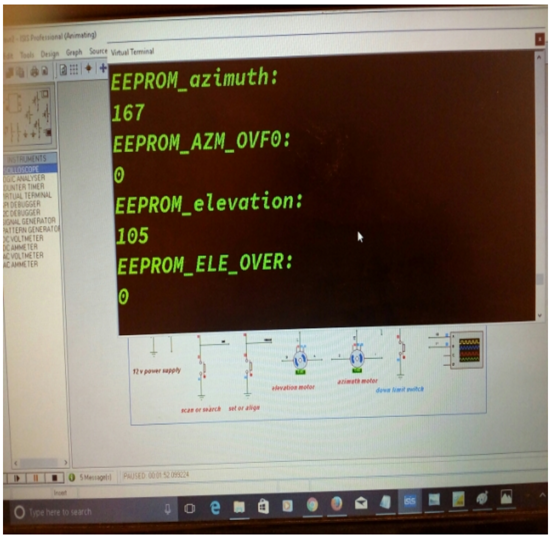


Figure 4.12: end of saving process

Figure 4.13 shows EEPROM contents before saving process and after saving process.Before saving process there was no contents saved.Then after end of saving process contents was 167 pulses for azimuth motor and 105 pulses for elevation motor and there was no overflow state.



(a) before saving process



(b) after saving process

Figure 4.13: EEPROM Contents

4.3 System Design

Figure 4.14 shows a prototype module for designed electronic circuit.

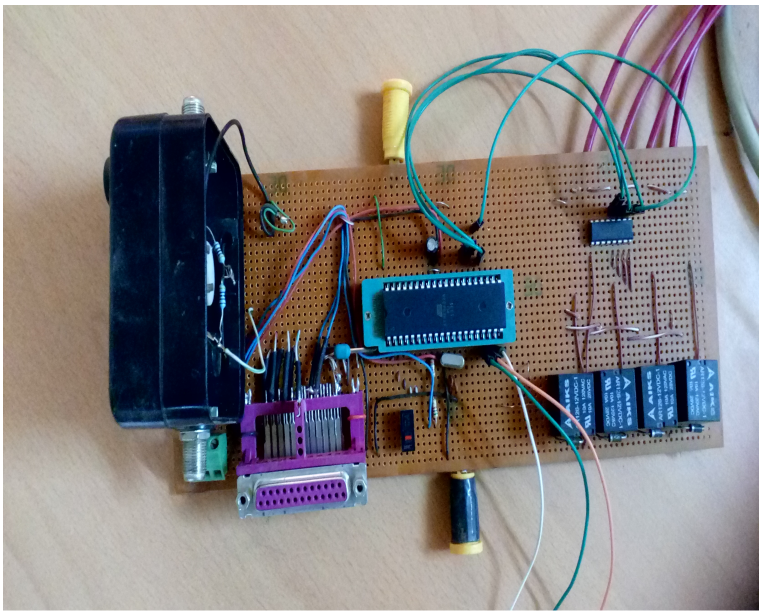


Figure 4.14: system electronic circuit

Figure 4.15 shows a prototype electronic circuit for designed system.

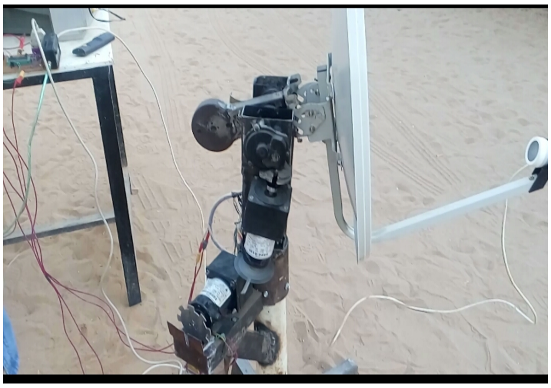


Figure 4.15: motorized antenna

4.4 Hardware System Operation

The operation of this system is divided into two stages

- scan (search)stage.
- set (align) stage.

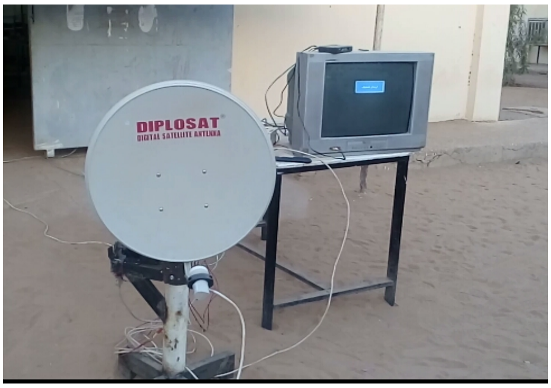
When antenna installed for the first time .The system(antenna system) must do the two above stages(scan set).
When we want to transfer from satellite to another the antenna system do only the second stage (align stage).

4.4.1 Scan (Search) Stage

In this stage the antenna begin it's movement from the reference position .This movement in pattern of pulses as in the figure 4.16 .

Figure 4.16: Antenna movement pattern

During this process the signal strength is monitored by MCU through signal detector .If the signal is strong enough (above threshold value) the movement is stopped at this moment antenna is aligned to the required satellite .



(a) Signal strength during scan process

(b) Signal above threshold value

After that antenna move or return to reference position (initial position). This return is done in two stages.First stage antenna azimuth return to it's reference azimuth and second stage antenna return to it's reference elevation. During the two return stages the feedback of motors (elevation motor and azimuth motor) is monitored through optocouplers .At the end of this stage (scan stage) the number of azimuth pulses and elevation pulses saved in the MCU EEPROM. Figure 4.18 shows elevation movement

Figure 4.18: Elevation Movement

4.4.2 Set (Align) Stage

In this stage the alignment process is done directly since the position of all satellite saved in EEPROM of MCU.

When we want to align antenna to specific satellite we press the required satellite button.Then the system response in three stages .in the first stage antenna move to it's reference position (direction).then in the second stage azimuth angle is set this done by start moving azimuth motor .This motor still moving until the number of current pulse pulses equals the saved number of azimuth pulses(in the EEPROM of MCU) of the required satellite (already been saved) .After that motor will stop .at this moment antenna azimuth angle is set.in the third stage elevation angle is set .This done by start moving elevation motor.This motor still moving until the number of current elevation pulses equals the saved number of elevation pulses(in the EEPROM of MCU) of required .After that motor will stop at this moment antenna elevation angle is set and antenna alignment process is done.

4.5 Results

Figure 4.19 shows that after final alignment process to specific satellite .The signal strength(signal quality) was 56%.This result was obtained by aligning the designed module to Nilesat satellite.

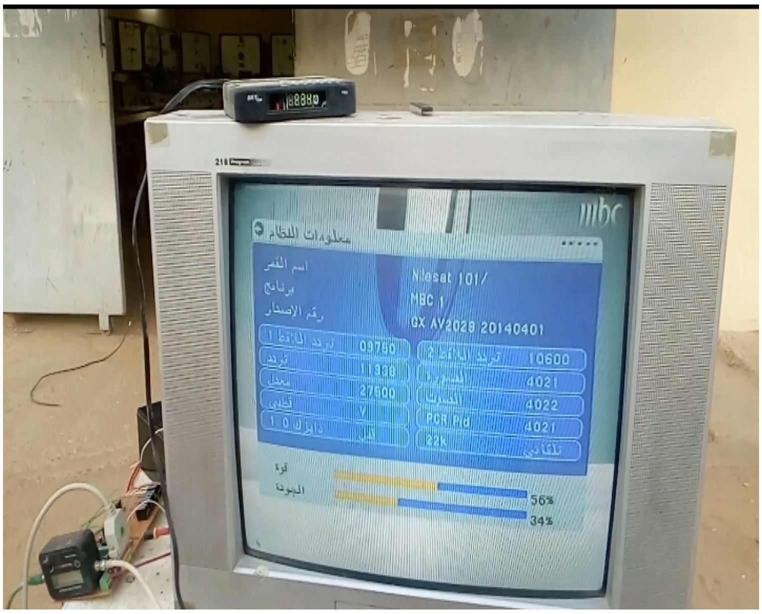


Figure 4.19: System Results

4.6 Chapter Summary

This chapter provides an overview of alignment system operation stages "scan or search stage and set or align stage".Also provides system flow chart for each stage of operation .Also provide an implementation and simulation for the system in proteus program .Also provide the result and discussion on system operation and result.

Chapter Five

CONCLUSION AND RECOMMENDATIONS

Chapter Five

Conclusion and Recommendations

5.1 Conclusion

Prototype module to align parabolic satellite antenna automatically has been designed and tested and it was successful at its major purpose of alignment process.The equipment's of the system are MCU,two dc motor (azimuth movement motor,elevation movement motor),two optocouplers,dc motor drivers(ULN2003,relays) ,parabolic dish with LNB ,mechanical parts,other accessories and programming part.The program was developed by using "BASCOM AVR ID" .The program do the "search + save" processes for any satellite available in the area of installation .After that when the user need to align to specific satellite he press the needed satellite button .The developed system makes the alignment process done easily ,quickly and accurately.

5.2 Recommendations

This thesis only solve the problem of alignment process in two dimensions X,Y so I recommend

- To use accelerometer module instead of optocoupler sensors which makes the . em more accurate syst
- To use servo motor or stepper motor where they provide more accuracy.

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APPENDICES

Appendix A : Program

```
$regfile = "m32def.dat"
$crystal = 4000000
$baud = 9600
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Config PORTD = Input
Config PORTC = Output
Config PORTB = Input
'~~~~~~~~~~~~~~~~~~~~~~~~VARIABLES~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~'
Dim Az_pulse_e As Eram Byte At 126 : Dim Overf0_e As Eram Byte At 128
Dim Elev_pulse_e As Eram Word At 164 : Dim Overf1_e As Eram Byte At 166
Dim Overf0 As Word : Dim Overf0_d As Word : Dim Ovf1 As Word
Dim Ovf1_d As Word : Dim N As Byte : Dim M As Byte : Dim A As Byte
Dim B As Word : Dim Detector As Integer : Dim Elev_pulse As Word
Dim Elev_pulse_d As Word : Dim Az_pulse As Byte : Dim Az_pulse_d As Byte
Dim G As Integer : Dim H As Integer : Dim X As Word : Dim Y As Byte
Dim Z As Integer : Dim O As Byte : Dim Savea As Byte : Dim Savee As Word
Dim Aa As Byte : Dim Bb As Byte : Dim Compensation As Word : Dim Last_value As Byte
'~~~~~~~~~~~~~~~~~~~~~~~~~~~GPIO CONFIGURATION~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Is_u Alias PINB.5
Is_d Alias PINB.2
Is_l Alias PINB.3
Is_r Alias PINB.4
Az_r Alias PORTC.1
Az_l Alias PORTC.2
Ele_u Alias PORTC.3
Ele_d Alias PORTC.4
Setx Alias PIND.4
Nilesatx Alias PIND.5
'~~~~~~~~~~~~~~~~~~~~~~~~adc configuration~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Config ADC = Single , Prescaler = Auto
Start ADC
'~~~~~~~~~~~~~~~~~~~~~~~~counters configurations~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Config TIMER0 = Counter , Edge = Falling , Clear Timer = 0
Config TIMER1 = Counter , Edge = Falling , Clear Timer = 0 , Prescale = 256 ,'Noise Cancel = 1
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~DEBOUNCE TIME~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Config Debounce = 100
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~pullup resistor~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
PORTD.4 = 1 : PORTD.5 = 1
'~~~~~~~~~~~~~~~~~~~~~~~~~~INTERRUPT CONFIGURATION~~~~~~~~~~~ ~~~~~~~~~~~~~~~~~~~~~~

'Config Int0 = Falling : On Int0 Seting : Enable Int0 : Portd.2 = 1
'Config Int1 = Falling : On Int1 Nilesat : Enable Int1 : Portd.3 = 1

'On Timer0 Isr1
'Enable Ovf0

Enable Interrupts
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

'~~~~~~~~~~~~~~~~~~~~~~~~MAIN LOOP~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Do

Debounce Setx , 0 , Seting , Sub
  If M = 3 Then
 Savea = Az_pulse_e
 Bb = Overf0_e
Savee = Elev_pulse_e
Aa = Overf1_e
M = 0
End If
Debounce Nilesatx , 0 , Nilesat , Sub
  ' Print "azimuth:" : Print Az_pulse
 ' Print "over_azimuth:" : Print Overf0
    Print "EEPROM_azimuth:" : Print Savea
     Print "EEPROM_AZM_OVF0:" : Print Bb
```

```
 'Print "elevation:" : Print Elev_pulse
' Print "OVER_ELEVATION:" : Print Ovf1
 Print "EEPROM_elevation:" : Print Savee
 Print "EEPROM_ELE_OVER:" : Print Aa
Loop
End

'~~~~~~~~SETING ROUTINE~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Seting:
Y = Ls_r
While Y <> 0
Set Az_r
Y = Ls_r
Wend
Reset Az_r
Z = Ls_d
While Z <> 0
Set Ele_d
Z = Ls_d
Wend
Reset Ele_d
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
X = Getadc(0)
While X < 190
X = Getadc(0)
G = Ls_u
While G <> 0 AND X < 290
Set Ele_u
X = Getadc(0)
G = Ls_u

Wend
Reset Ele_u
G = Ls_u
X = Getadc(0)
If G = 0 AND X < 290 Then
  Set Az_l
  End If
  Waitms 150
  Reset Az_l
  H = Ls_d
  X = Getadc(0)
  While H <> 0 AND X < 290
  Set Ele_d
   H = Ls_d
  X = Getadc(0)
  Wend
  Reset Ele_d
   H = Ls_d
   X = Getadc(0)
  If H = 0 AND X < 290 Then
  Set Az_l
  End If
  Waitms 150
  Reset Az_l
  Wend
  Waitms 400


  '~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  Start COUNTER0
   TCNT0 = 0
 Overf0 = 0
 Y = Ls_r
  While Y <> 0
```

```
Set Az_r
O = TIFR.0
If O = 1 Then
 Incr Overf0
  Set TIFR.0

End If

 Y = Ls_r
Wend
Reset Az_r

Az_pulse = COUNTER0
Az_pulse_e = Az_pulse
Overf0_e = Overf0
M = 3
Stop COUNTER0
   Start Counter1
 TCNT1 = 0
 Ovf1 = 0
Z = Ls_d
While Z <> 0
Set Ele_d
If TIFR.2 = 1 Then
 Incr Ovf1
  Set TIFR.2
 End If

Z = Ls_d
Wend
Reset Ele_d

Elev_pulse = Counter1

 Elev_pulse_e = Elev_pulse
 Overf1_e = Ovf1
     N = 3
Stop Counter1

Return

'~~~~~~~~~~~~~~~nilesat routine~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 Nilesat:
 Y = Ls_r
While Y <> 0
Set Az_r
Y = Ls_r
Wend
Reset Az_r
Z = Ls_d
While Z <> 0
Set Ele_d
Z = Ls_d
Wend
Reset Ele_d
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

  Start COUNTER0
   TCNT0 = 0
   Overf0_d = 0
 A = 0
 Savea = Az_pulse_e
 Bb = Overf0_e
 While Overf0_d <> Bb
 Set Az_l
```

```
 O = TIFR.0
If O = 1 Then
 Incr Overf0_d
  Set TIFR.0

End If
 A = COUNTER0

 Wend

 While A <> Savea
 Set Az_l
   A = COUNTER0
 Wend
 Reset Az_l
 Stop COUNTER0
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 Start Counter1
 TCNT1 = 0
 Ovf1_d = 0
 Savee = Elev_pulse_e
Aa = Overf1_e
 B = 0

 While Ovf1_d <> Aa
 Set Ele_u
 If TIFR.2 = 1 Then
 Incr Ovf1_d
  Set TIFR.2
 End If

B = Counter1
 Wend
 While B <> Savee
  Set Ele_u
 B = Counter1
 Wend
 Reset Ele_u
 Stop Counter1
 '~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~compensation error~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 Waitms 1000
 Start COUNTER0
 TCNT0 = 0
 Z = Ls_r
  X = Getadc(0)
 Compensation = COUNTER0
While X < 270 AND Compensation < 200
If Z <> 0 Then
Set Az_r

End If

 X = Getadc(0)
 Z = Ls_r
 Compensation = COUNTER0
Wend
Reset Az_r
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 TCNT0 = 0
  X = Getadc(0)
  Z = Ls_l
  Compensation = COUNTER0
While X < 270 AND Compensation < 200
If Z <> 0 Then
Set Az_l

End If
```

```

 X = Getadc(0)
 Z = Ls_l
 Compensation = COUNTER0
Wend
Reset Az_l

'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 TCNT0 = 0
  X = Getadc(0)
  Z = Ls_l
  Compensation = COUNTER0
While X < 270 AND Compensation < 200
If Z <> 0 Then
Set Az_l

End If

 X = Getadc(0)
 Z = Ls_l
 Compensation = COUNTER0
Wend
Reset Az_l
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 TCNT0 = 0
 Z = Ls_r
  X = Getadc(0)
 Compensation = COUNTER0
While X < 270 AND Compensation < 200
If Z <> 0 Then
Set Az_r

End If

 X = Getadc(0)
 Z = Ls_r
 Compensation = COUNTER0
Wend
Reset Az_r

'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
Start Counter1
 TCNT1 = 0
  X = Getadc(0)
  Z = Ls_u
    Compensation = Counter1
While X < 270 AND Compensation < 100

If Z <> 0 Then
Set Ele_u

End If
 X = Getadc(0)
 Z = Ls_u
 Compensation = Counter1
Wend
Reset Ele_u
'~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
 TCNT1 = 0
  X = Getadc(0)
  Z = Ls_d
    Compensation = Counter1
While X < 270 AND Compensation < 350

If Z <> 0 Then
Set Ele_d
End If
 X = Getadc(0)
 Z = Ls_u
  Compensation = Counter1
Wend
Reset Ele_d
Stop Counter1
```

Appendix B : Atmega32 Features

Features	ATmega32A
Pin count	44
Flash (KB)	32
SRAM (KB)	2
EEPROM (KB)	
General Purpose I/O pins	32
SPI	1
TWI (I2C)	1
USART	1
ADC	10-bit, up to 76.9ksps (15ksps at max resolution)
ADC channels	8
AC propagation delay	Typ 400ns
8-bit Timer/Counters	2
16-bit Timer/Counters	1
PWM channels	4
RC Oscillator 2.7 - 5.5V	+/-3heightOperating voltage
Max operating frequency	16MHz
Temperature range	-55C to +125C
JTAG	Yes