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DHAKA, BANGLADHESH

ORGANIZATION OF ISLAMIC COOPERATION

DESIGN AND ANALYSIS OF AN INTELLIGENT STICK FOR BLIND

A thesis submitted to the department of Mechanical and chemical Engineering (MCE), Islamic University of Technology (IUT), in the partial fulfillment of the requirement for degree of Bachlor of Science in Mechanical Egineering.

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CERTIFICATE OF RESEARCH

The thesis title **"DESIGN AND ANALYSIS OF AN INTELLIGENT STICK FOR BLIND"** submitted by Muhammad Anas (Student no: 101443) and Muhammad Waqas (Student no: 101449) has been accepted as satisfactory in partial fulfillment of the requirement for the Degree of BSc in Mechanical and Chemical Engineering on october, 2014.

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DECLARATION

It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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I also thank to all my friends, colleagues and whoever helped us in the course of our work and or write-up.

We seek excuse for any errors that might occur in this report despite of our best efforts.

ABSTRACT
The thesis presents a theoretical and practical model and a system concept to provide a smart electronic aid for blind people. The system is intended to provide overall measures – Artificial vision and object detection. The aim of the overall system is to provide a low cost and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of objects around them.

Ultrasonic sensors are used to calculate distance of the obstacles around the blind person and water sensor detects any water surfaces to guide the user towards the available path. Output is in the form of vibrations or voice. The hardware consists of Arduino Uno board, ultrasonic sensors, water sensor and vibrator. The secondary sonar sensor fitted on the bottom of the stick will detect any hole or trench in the way and will notify the user.

The thesis contains the work on the design and working of practical model for artificial guidance and explains properly the working principle of the intelligent stick. The arduino program defines all the possible scenarios that may occur in the normal life of a blind person and will help to solve it. Computer simulations were performed in order to find the traces of the guide stick at three different conditions using an in-house arduino software. The intelligent guide stick will help the blind travel with providing more convenient means of life.

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CHAPTER 1

INTRODUCTION:

The importance of sensorial and communicational functions results from the fact that the human body is an open biosystem, in a permanent exchange of energy, substances and information with the environment. The human being receives information from the environment: 1% by taste, 1,5% by tactile sense, 3,5% by smell, 11% by hear and 83% by sight.
For an efficient reintegration of the disabled people in the family and society, it is strongly needful to assist their diminished functions or to replace the totally lost functions. Thus, a new branch of technology and engineering is developing: Assistive Technology, meaning any product, instrument, equipment or technical system used by a disabled person, especially produced or generally available, preventing, compensating, relieving or neutralizing the impairment, disability or handicap.
Visual impairment refers not just to a total blindness, but to a more common problem of partial or low vision. It is caused by many different conditions conducting to a variety of perceptual problems: macular degeneration reduces clarity of central vision, advanced retinitis pigments produces a “tunnel” vision, cataracts cloud or blur images, diabetic retinopathy produces overall dimness, blank or unclear areas, temporary or permanent, optic nerve atrophy superimposes cultured forms on an image, also. Because the problems of visual impairment are much diversified, the solutions for assisting or replacing the visual sense vary too.

The traditional and oldest mobility aids for persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs. The most important drawbacks of these aids are necessary skills and training phase, range of motion and very little information conveyed.
The aim of this paper is to describe new methods of guiding visually impaired persons and to present a new low cost system, called “mechatronic blind stick” which is easy to use by visually impaired persons.

1.1 Problem Statement:

Vision is the most important part of human physiology as 83% of information human being gets from environment is via sight. To identify and analyze **economical** technologies that aids the blind and visually impaired in education, preparation for work, and in employment.

Navigation of blind people is very arduous because they must use the white cane for obstacle detection while following the front sides of houses and shops, meanwhile memorizing all locations they are becoming familiar with. In a new, unfamiliar setting they completely depend on people passing by to ask for a certain shop or the closest post office. Crossing a street is a challenge, after which they may be again disoriented.

The most important function for the blind persons is to get information on the shape of the road and the position of obstacles when they are in unknown places. With this information, they need to arrive at their destinations avoiding unexpected obstacles.

1.2 Background:

Vision is the most important part of human physiology. The 2011 statistics by the World Health Organization (WHO) estimates that there are 285 billion people in world with visual impairment, 39 billion of which are blind and 246 with low vision. The traditional and oldest mobility aids. For persons with visual impairments are the walking cane (also called white cane or stick) and guide dogs. The most important drawbacks of these aids are necessary skills and training phase range of motion and very little information conveyed. With the rapid advances of modern Technology, both in hardware and software front have brought potential to provide intelligent navigation capabilities. Recently there has been a lot of Electronic Travel Aids (ETA) designed and devised to help the blind navigate independently and safely. Also high-end technological solutions have been introduced recently to help blind persons navigate independently .Many blind guidance systems use ultrasound because of its immunity to the environmental noise. Another reason why ultrasonic is popular is that the technology is relatively inexpensive, and also ultrasound emitters and detectors are small enough to be carried without the need for complex circuit.

1.3OBJECTIVES:

- The main aim of the project is to provide artificial guidance to physically impaired persons with the help of an ultrasonic sensor, water sensor and a vibrator for detection of obstacle.
- Additional objective is to use the “gripper’ mechanism which will stimulate the blood through fingers.
- Theoretical study.
- CAD Design.
- Fabrication and Assembly.

1.4 Significance of study:

The purpose of the present study is to develop a simple robot-type guidance system for the blind which traces the position of the moving guide stick, using an ultrasonic sensor and sensors, and to determine whether the blind moves safely. Blind person can have an additional advantage of having water detection mechanism through which he can move easily.

Also the special medicated gripper is introduced to have a check on blind person’s health.

CHAPTER#2

LITERATURE REVIEW:

Hemispherical ultrasound sensor array:

Different approaches exist to help the visually impaired. One system for obstacle avoidance is based on a **hemispherical ultrasound sensor array**. It can detect obstacles in front and unimpeded directions are obtained via range values at consecutive times. The system comprises an embedded computer, the sensor array, an orientation tracker and a set of pager motors. Talking points is an urban orientation system based on electronic tags with spoken (voice) messages. These tags can be attached to many landmarks like entrances of buildings, elevators, but also bus stops and busses. A push-button on a hand-held device is used to activate a tag, after which the spoken message is made audible by the device's small loudspeaker. Isonic is a travel aid complementing the cane. It detects obstacles at head-height and alerts by vibration or sound to dangerous situations, with an algorithm to reduce confusing and unnecessary detections. iSONIC can also give information about object color and environmental brightness.

Guide Cane:

It is a computerized travel aid for blind pedestrians. It consists of a long handle attached to a sensor unit on a small, lightweight and steerable device with two wheels. While walking, the user holds the handle and pushes the Guide Cane in front. Ultrasonic sensors detect obstacles and steer the device around them. The user feels the steering direction through the handle and can follow the device easily and without conscious effort. Drishti is an in- and outdoor navigation system. Outdoor it uses DGPS localization to keep the user as close as possible to the central line of sidewalks. It provides the user with an optimal route by means of its dynamic routing facility. The user can switch the system from out- to indoor operation with a simple vocal command which activates a precise ultrasound positioning system. In both cases the user gets vocal prompts which alert to possible obstacles and which provide guidance while walking about.

CASBliP or Cognitive Aid System :

This system for Blind People was a European Union-funded project. The main aim was to develop a system capable of interpreting and managing real-world information from different sources in order to improve autonomous mobility. Environmental information from various sensors is acquired and transformed into enhanced images for visually impaired users or into acoustic maps via headphones for blind users. Two prototypes were developed for the validation of the concepts. The first was an acoustic prototype containing a novel time-of-flight CMOS range-image sensor mounted on a helmet, in combination with an audio interface for conveying distance information through a specialized sound map. The second was a real-time mobility-assistance prototype equipped with several environmental and user interfaces for safe in- and outdoor navigation.

System for Wearable Audio SWAN or Navigation:

It is a project of the Sonification Lab at Georgia Institute of Technology . The core system is a wearable computer with a variety of location- and orientation-tracking technologies, including GPS, inertial sensors, pedometer,RFID tags, RF sensors and a compass. Sophisticated sensor fusion is used to determine the best estimate of the user's actual location and orientation. Tyflos-Navigator is a system which consists of dark glasses with two cameras, a portable computer, microphone, earphones and a 2D vibration array . It captures stereo images and converts them into a 3D representation. The latter is used to generate vibration patterns on the user's chest, conveying distances of the user's head to obstacles in the vicinity. The same authors presented a detailed discussion of other relevant projects concerning navigation capabilities .

Similar initiatives exploited other sensor solutions, for example an IR-multi sensor array with smart signal processing for obstacle avoidance and a multi-sonar system with vibro-tactile feedback. One system is devoted to blind persons in a wheelchair . Information of the area around the wheelchair is collected by means of cameras mounted rigidly to it. Hazards such as obstacles, drop-offs ahead of or alongside the chair, veering paths and curb cuts can be detected for finding a clear path and maintaining a straight course. All camera information can be combined with input from other sensors in order to alert the user by synthesized speech, audible tones and tactile cues.

From the overview presented above we can conclude that technologically there are many possibilities which can be exploited. Some are very sophisticated, but also very complex and likely too expensive for most blind persons who, in addition to having to deal with their handicap, must make both ends meet financially. Moreover, ergonomically most may prefer not to wear a helmet or to use other visually conspicuous devices which set them apart. Many previous initiatives were very ambitious in the sense that information from many sensors was integrated for solving most problems one can imagine. An additional aspect is that complex systems are difficult to assemble and integrate, and they require maintenance by professional technicians.

Fig2.1 Examples of representative mobility aids for visual impaired persons

CHAPTER 3

ELECTRIC CIRCUIT:

3.1BLOCK DIAGRAM:

The block diagram of the circuit for intelligent stick is shown in Fig 3.1.

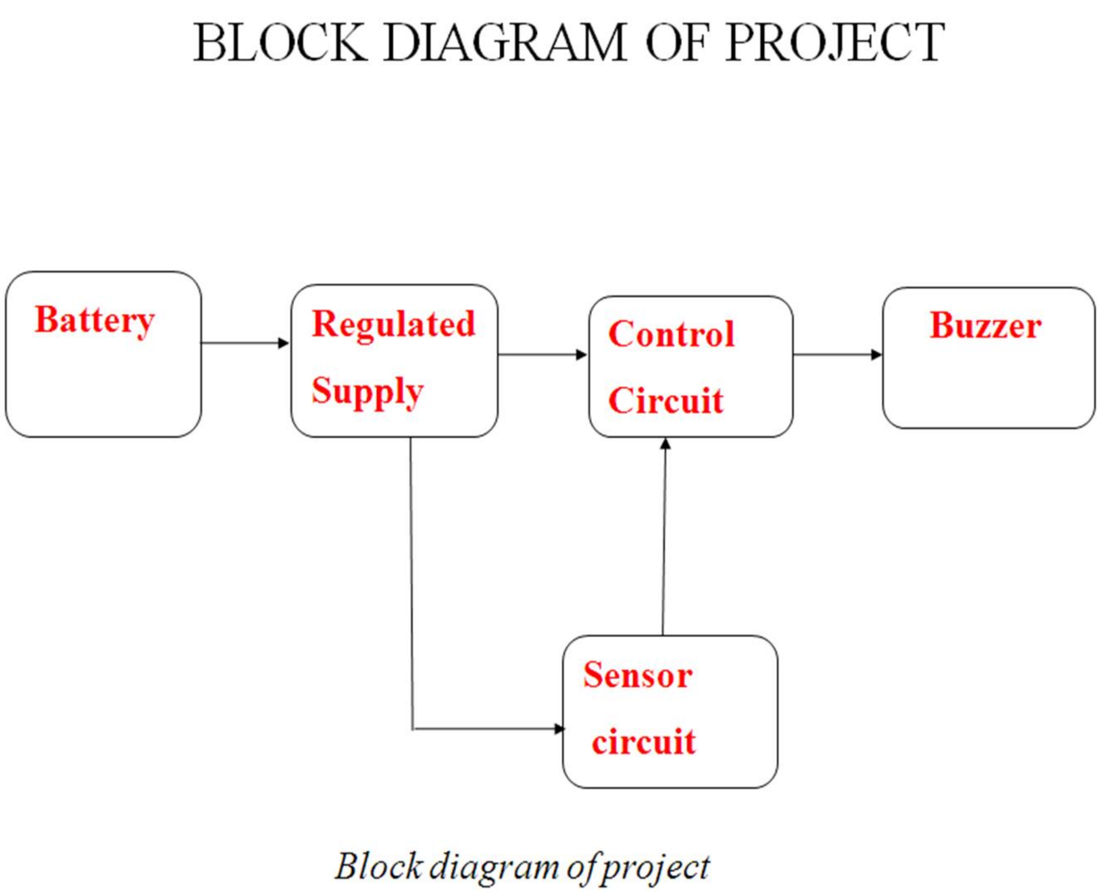


Fig 3.1

3.2CIRCUIT DIAGRAM:

The circuit diagram of the circuit for intelligent stick is shown in Fig 2.2.

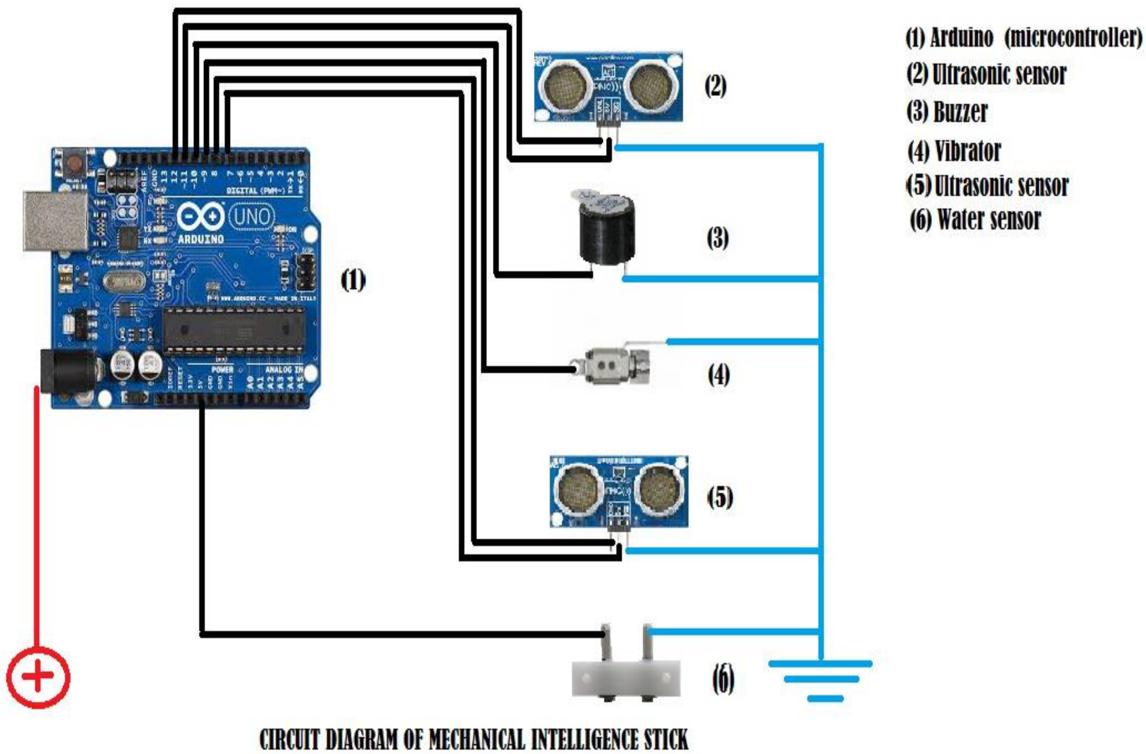


Fig 3.2

EXPLANATION:

In the fig 2.2 various components are shown along with different numbers assigned to each of them. The positive terminal of portable and rechargeable battery is connected to the microcontroller. Usually the power supplied to arduino is about 9volts.the programming is done on microcontroller by the help of programming soft wares like C & C++,to make the arduino use the system according to requirements of the user. In the given project two types of sensors are being used for detection and sensing for helping the blind person in walking. The circuit is designed and programmed in such a way that when an object comes in range of 1m of the ultrasonic sensor, it gives a signal to the microcontroller which turns on the buzzer or vibrator.Similar case occurs when the bottom of stick carrying water sensor comes in contact with water. The sensors and devices are connected to negative terminal of battery as in Fig 3.2.

3.3 COMPONENTS:

The various components used in the circuit are followings along with their explanation.

a) ULTRASONIC SENSOR:

An ultrasonic sensor is a device that works in much same way as RADAR and SONAR. In fact, ultrasonic sensors mimic bats and other animals' natural ability to use ultrasonic frequencies for navigation. Ultrasonic sensors broadcast a powerful, ultrasonic frequency, then detect the ultrasonic sound waves as they bounce off of objects and return to the sensor. They are almost always used to measure speed or direction and are efficiently at determining position. Ultrasonic sensors are commonly used for a wide variety of noncontact presence, proximity, or distance measuring applications. These devices typically transmit a short burst of ultrasonic sound toward a target, which reflects the sound back to the sensor. The system then measures the time for the echo to return to the sensor and computes the distance to the target using the speed of sound in the medium. The first step toward identifying the right proximity sensor for your application is to understand the fundamental ultrasonic properties of the transmission medium and the way they influence the measurement and system operation.

WORKING PRINCIPLE:

Ultrasonic sensors depend on two separate devices: an ultrasonic transducer and a detector. An ultrasonic transducer is any device that converts energy into an ultrasonic frequency. Though dog whistles and several other devices can convert mechanical energy into an ultrasonic frequency, ultrasonic transducers are usually made from piezoelectric crystals that can change size when a voltage is applied to them. When an alternating current is applied to a piezoelectric crystal, it vibrates extremely fast and produces an ultrasonic sound wave. The detector is also made of a piezoelectric crystal, but produces a voltage when an ultrasonic frequency comes in contact with it, effectively producing the opposite results. A sensor calculates the time that it takes in between broadcasting the ultrasonic frequency and receiving the incoming waves.

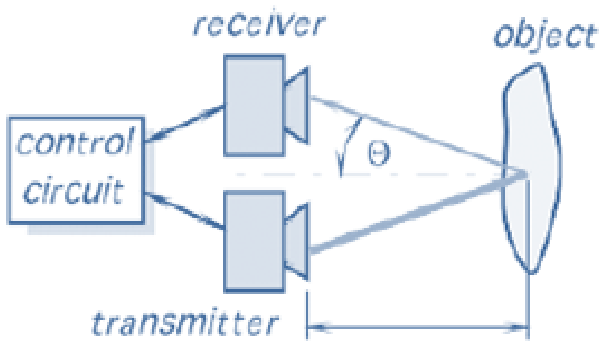


Fig (a)

Ultrasonic sensing/control basics:

Ultrasonic signals are like audible sound waves, except the frequencies are much higher. Our ultrasonic transducers have piezoelectric crystals which resonate to a desired frequency and convert electric energy into acoustic energy and vice versa. The illustration shows how sound waves, transmitted in the shape of a cone, are reflected from a target back to the transducer. An output signal is produced to perform some kind of indicating or control function. A minimum distance from the sensor is required to provide a time delay so that the "echoes" can be interpreted. Variables which can affect the operation of ultrasonic sensing include: target surface angle, reflective surface roughness or changes in temperature or humidity. The targets can have any kind of reflective form - even round objects.

Ultra Sonic's is the study and application of high-frequency sound waves, usually in excess of 20KHz(20,000 cycles per second).Modern ultrasonic generators can produce frequencies of as high as several gigahertz (several billion cycles per second) by transforming alternating electric currents into mechanical oscillations, and scientists have produced ultrasound with frequencies up to about10GHz (ten billion vibrations per second). There may be an upper limit to the frequency of usable ultrasound, but it is not yet known. Higher frequencies have shorter wavelengths, which allow them to reflect from objects more readily and to provide better information about those objects. However, extremely high frequencies are difficult to generate and to measure.

Detection and measurement of ultrasonic waves is accomplished mainly through the use of piezoelectric receivers or by optical means. The latter is possible because ultrasonic waves are rendered visible by the diffraction of light. Ultrasound is far above the range of human hearing, which is only about 20Hz to 20 KHz. However, some mammals can hear well above this. For example, bats and whales use echolocation that can reach frequencies in excess of 100 KHz.

b) WATER SENSOR:

Water sensor detects the presence of water at its contact with water. We can use impedance moisture sensor as the water sensor as shown in fig 3.3.

Impedance Moisture Sensor

Modern impedance dew point sensors are typically constructed using state-of-the-art thin and thick film techniques. Operation of the sensor depends upon the adsorption of water vapor into a porous non-conducting "sandwich" between two conductive layers built on top of a base ceramic substrate.

The active sensor layer and the porous top conductor, that allows transmission of water vapors into the sensor, are engineered very thinly. Therefore the sensor responds very rapidly to changes in applied moisture, both when being dried (on process start-up) and when called into action if there is moisture ingress into a process. Despite this extreme sensitivity to changes in moisture content, the Impedance Moisture Sensor can be incredibly rugged due to the nature of its construction. To protect the sensor further against contaminants and pipe swerve it recommended that the sensor is housed in a protective sintered stainless steel guard.

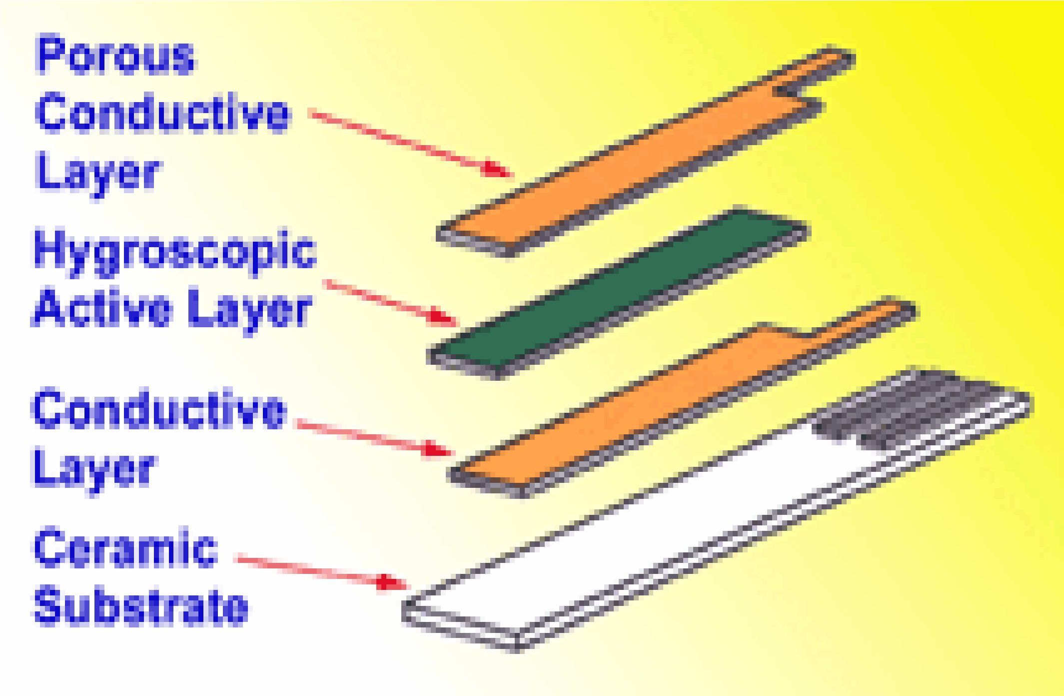


Fig 3.3(water sensor)

Water sensor is fitted at the bottom of the stick so when the stick comes in contact with water the vibrator or buzzer is turned on through the signal provided to microcontroller (arduino).

Chilled Mirror Technology

Chilled Mirror Sensors are fundamental in their method of operation. A miniature polished metal mirror is cooled by a solid state pettier thermoelectric heat pump until it reaches the dew point of the gas under test. When this temperature has been reached, condensation will begin to form on the mirror surface.

An electro-optical loop detects that condensation is forming, by a reduction in the intensity of light reflected from the mirror surface and through the control electronics of the cooled mirror instrument.

This modulates the cooling power applied to the Pettier. The mirror surface is then controlled in an equilibrium state whereby evaporation and condensation are occurring at the same rate. In this condition the temperature of the mirror (measured by a platinum resistance thermometer) is equal to the dew point temperature of the gas.

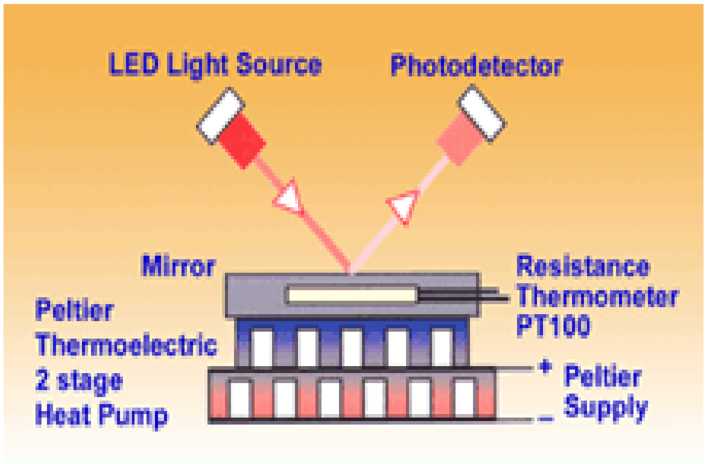


Fig (3.4) water sensor

c) MICROCONTROLLER:

ARDUINO:

Arduino is a single-board microcontroller, intended to make the application of interactive objects or environments more accessible. The hardware consists of an open source hardware board designed around an 8-bit Atmel AVR microcontroller shown in Fig (2.5).
It comes with a simple integrated development environment (IDE) that runs on personal computers and allows writing programs for Arduino in C or C++.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Fig (3.5)

POWER:

The Arduino Uno can be powered via the USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and VIN pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

• VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

• 5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V) or the VIN pin of the board (7-12V).
• 3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50mA.
• GND. Ground pins.

Shields in Arduino:

There are also different Arduino shields

• LEDs and switches shield
• LCD and sensors shield
• Audio shield
• Triac shield
• Motor shield
• ADC/DAC shield
• Bluetooth shield
• ZigBee shield

Each shield will cater to one or more experiments. The Uno board will be USB powered.

d) BUZZER:

A buzzer or beeper is an audio signaling device which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

There are two connections for speaker the positive and the negative. The positive of speaker is connected to pin no 11 of Arduino through 100ohms resistor. In the absence of the resistor there will be an increase in the load on the Arduino Uno board, thus resulting in the damage of the board. The

negative of the speaker is connected to the ground pin of the Arduino Uno board.
Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.
A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used to indicate that a button has been pressed are a click, a ring or a beep.

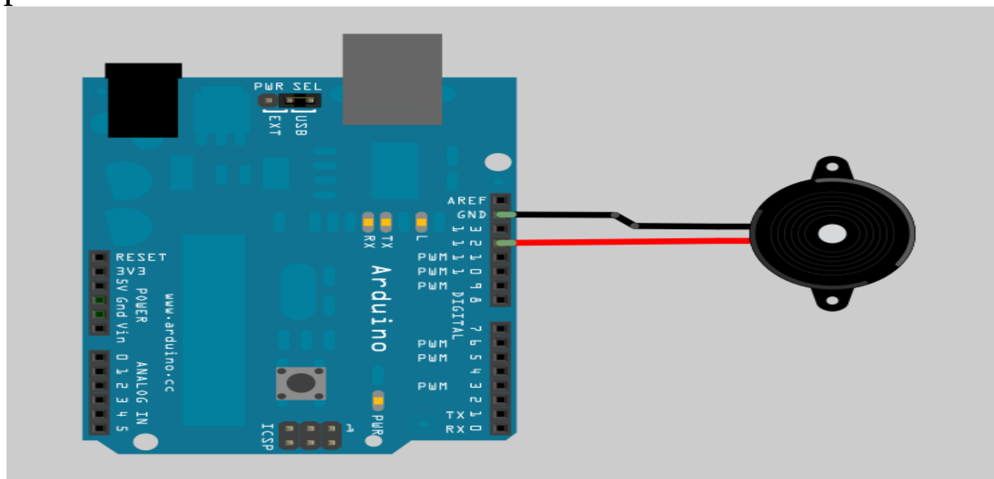


Fig (3.6) **Buzzer** (with arduino)

e) VIBRATOR:

The vibrator is used as a replica for buzzer or it can also be used along with the buzzer for the detection of any obstacle or water bodies coming in contact with the intelligent stick. It is shown in figure.
These days miniature vibrating motors are used in a wide range of products, like tools, scanners, medical instruments, GPS, and control sticks. Vibrator motors are also the main actuators for haptic which is an inexpensive way to increase a product's value, and differentiate it from competition. Today, designers and users alike have learned from two decades of mobile phones, that vibration alerting is an excellent way to alert operators of an event. Vibration alerting is a common application for these vibrations motors

to be used. Also although they are small in size, they can still be powerful enough to be used in massaging and stimulation applications.

Mechanical Vibrator

H-BRIDGE:

As the power delivered from the arduino is not enough to run the vibrator effectively and could cause damage to the microcontroller. So we used the application of H-Bridge which will take signal from the arduino but will get the power directly from the battery. It consist of a transistor.

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. A common variation of this circuit uses just the two transistors on one side of the load, similar to a class AB amplifier. Such a configuration is called a "half bridge". The half bridge is used in some switched-mode power supplies that use synchronous rectifiers and in switching amplifiers. The half-H bridge type is commonly abbreviated to "Half-H" to distinguish it from full ("Full-H") H bridges. Another common variation, adding a third 'leg' to the bridge, creates a three-phase inverter. The three-phase inverter is the core of any AC motor drive.

A further variation is the half-controlled bridge, where the low-side switching device on one side of the bridge, and the high-side switching device on the opposite side of the bridge, are each replaced with diodes. This eliminates the shoot-through failure mode, and is commonly used to drive variable or switched reluctance machines and actuators where bi-directional current flow is not required.

A common use of the H bridge is an inverter. The arrangement is sometimes known as a single-phase bridge inverter.

The H bridge with a DC supply will generate a square wave voltage waveform across the load. For a purely inductive load, the current waveform would be a triangle wave, with its peak depending on the inductance, switching frequency, and input voltage.

f) RECHARGEABLE BATTERY:

A rechargeable battery, storage battery, or accumulator is a type of electrical battery. It comprises one or more electrochemical cells, and is a type of energy accumulator used for electrochemical energy storage. It is technically known as a secondary cell because its electrochemical reactions are electrically reversible. Rechargeable batteries come in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network. Several different combinations of chemicals are commonly used, including: lead–acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).

Rechargeable batteries have a lower total cost of use and environmental impact than disposable batteries. Some rechargeable battery types are available in the same sizes as common consumer disposable types. Rechargeable batteries have a higher initial cost but can be recharged inexpensively and reused many times. The rechargeable battery also supports the H Bridge.

Fig (3.7) rechargeable battery

g) POWER BOOSTER:

A Booster was a motor-generator set used for voltage regulation in direct current (DC) electrical power circuits. The development of alternating current and state devices has rendered it obsolete. Boosters were made in various configurations to suit different applications.

Battery booster is an all-in-one battery boosting and power management tool for both Android smartphone and tablet. It provides the most accurate battery information, keeps track of the recent battery changes, monitors battery-draining processes, and helps you deal with various battery wasting situations at ease.

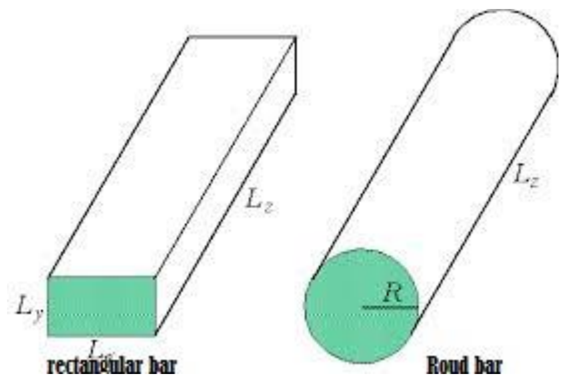
Battery Booster allows you to optimize you Battery Performance to the maximum level.

Fig (3.8) Power Booster

SOLIDWORKS DESIGNS:

3.4) Design parameters:

The shape of stick was considered circular instead of rectangular as it provides more stability and strength to the design.



Round Intelligent stick is more efficient and more flexible than rectangular one. The line of action of all the forces acting (on the round stick) in the same manner while the line of action of forces acting (on the rectangular stick) in different manner.

Round Stick should be weld and adjust easily as compare to rectangular one. The Round stick should be hollow by keeping the circuit and components in.The hollow stick is lighter (and cheaper as less material needed) and is therefore preferred in some applications where weight is important. Hollow rods have no fixed center of axis.

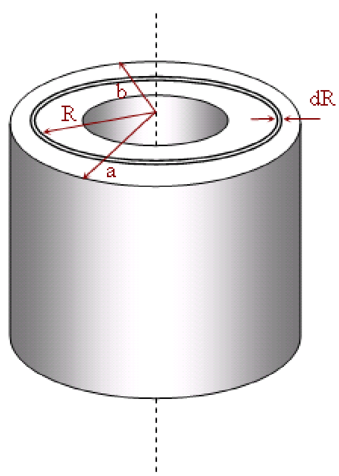
If you compare the bending stiffness and strength of a hollow stick with a solid rod (stick) of the same diameter, the hollow stick has material where the bending stress concentration is the largest (i.e., nearest the outer surface). Thus, while not as stiff/strong as the solid rod (stick), the strength ratio is greater than the cross-section area ratio. So comparing the same cross-section area hollow stick and solid rod (stick), the hollow stick is actually the outer part of a larger rod and is stronger than the smaller rod.

Stress in a rectangular stick is inversely proportional to cross-section height^2*width. Similarly, for a round stick one can say that stress is roughly inversely proportional to diameter^3. So let's compare a 1-inch solid rod with a hollow stick of the same cross section formed as the outer 1/4 of the cross section of a 2-inch rod. The 2-inch rod, if solid, would be 8 times as strong as the 1-inch. The cylinder has at least 1/4 the strength of the solid (and more if we consider the stress concentration effect mentioned above), or at least twice the strength of the 1-inch.

In general a 1 inch solid rod (stick) is more "stable" than a 1 inch hollow rod (stick) but for a given amount of weight, a 1 inch solid rod (stick) is less "stables" than, say a 6 inch hollow rod (stick), with the same amount of aluminum.

A solid stick can be twisted more easily than a hollow stick.

Moment of inertia of a uniform hollow stick.



We know that the moment of inertia for hoop with radius R is mR2. We can divide stick into thin concentric hoops of thickness dir.
Density = Mass per unit volume
Density = dam / dB

$$\rho = \frac{dm}{dV}$$

þ; - Density
dm - Mass of a ring or radius R
dV - Volume of a ring or radius R

Let's assume height of the stick is h.

$$dV = 2\pi R \times dR \times h$$

$$\rho = \frac{dm}{2\pi R \times dR \times h}$$

$$dm = 2\pi R \cdot h \cdot \rho \cdot dR$$

We can obtain moment of inertia by integrating over all these hoops

$$I = \int R^2 dm$$

Stick has uniform density, where þ = constant

$$I = 2\pi h\rho \int_b^a R^3 dR$$

$$I = \pi h\rho \left(\frac{a^4 - b^4}{2} \right)$$

Volume of this stick is

$$V = \pi \cdot a^2 h - \pi \cdot b^2 h$$

$$V = \pi h \left(a^2 - b^2 \right)$$

Mass M is

$$M = \rho V$$

$$M = \pi h \rho \left(a^2 - b^2 \right)$$

$$I = \pi h \rho \left[\frac{(a^2 - b^2)(a^2 + b^2)}{2} \right]$$

Moment of inertia for hollow stick is

$$I = \frac{1}{2} M (a^2 + b^2)$$

Material selection (Aluminum Alloy):

Two options were considered for the selection of material for the stick to be made.one was to use wood and other was to use aluminum alloy pipes.

The strength of aluminum is more than that of wooden stick of same length and diameter so aluminum was preferred. Also the aluminum alloy has a higher life period and is less exposed to any damage through atmosphere. But it's expensive than wood. The cost can be compensated as less machining effort is required on aluminum than on wood.

So finally Aluminum Alloy is selected for design.

3.5) Average of height of intelligent stick:

- After studying the average height of people and the comfort level during use, the length of stick is considered as 2.3 feet (27").

- Too short or too long intelligent stick would put the inspired person in trouble. The selection can be done according to Fig 3.9.

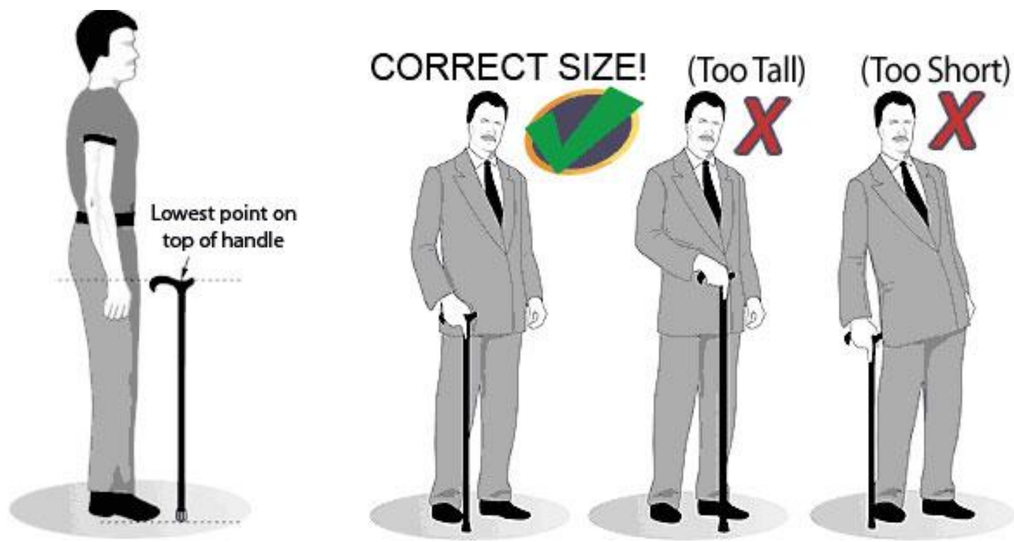


Fig 3.9

- Regarding the average height of the people (Blind people) we chosen the correct height of intelligent stick is considered as 2.3 feet (27”) for suitable guidance.

- The intelligent stick is designed in such a way that it can provide assistance to a **cripple person** by bearing his weight as fig 3.10.

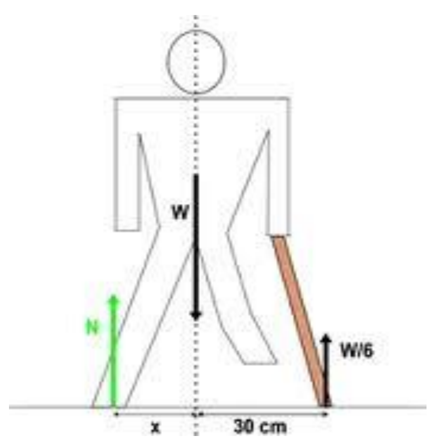


Fig 3.10

3.6) CAD DESIGNS:

Function of the sticks:

Canes or walking canes are just one of several devices available to assist in ambulation, or walking. Using a walking cane improves balance by increasing a person's base of support. When used correctly, canes unload the leg opposite to the hand the cane is in by up to twenty five percent.

1st and 2nd Design (Functional grip cane);

Functional grip intelligent stick is similar to the c cane except for the handle. A functional grip intelligent stick has a round grip handle or straight handle (as for 1st design) with a small doom types on it. This allows for a better grip by the patient. Improved grip allows for better cane control and hence offers more support than the c cane. Functional grip intelligent stick is appropriate for the patient who needs slightly more balance assistance than the c cane provides.

Functional grip having small doom for better gripping as well as stimulates blood through figure with help of vibrator response.Functional gripper is automatically adjustable with along different hands.Functional grip intelligent stick has the ability to carry the weight of inspired person along with guidance.

3rd Design(C cane);

The C cane is a single straight walking cane with a curve forming a handle at its top. This is the most simple of all canes. It assists in improving balance by the mechanism described above. Straight canes should be used by the patient needing only slight assist with balance or only minimal unweighting of the opposite leg.

C cane should not carry the weight of blind person it well just guide the inspired person against any wizard.

SOLID WORKS DESIGNS:

DESIGN (1):

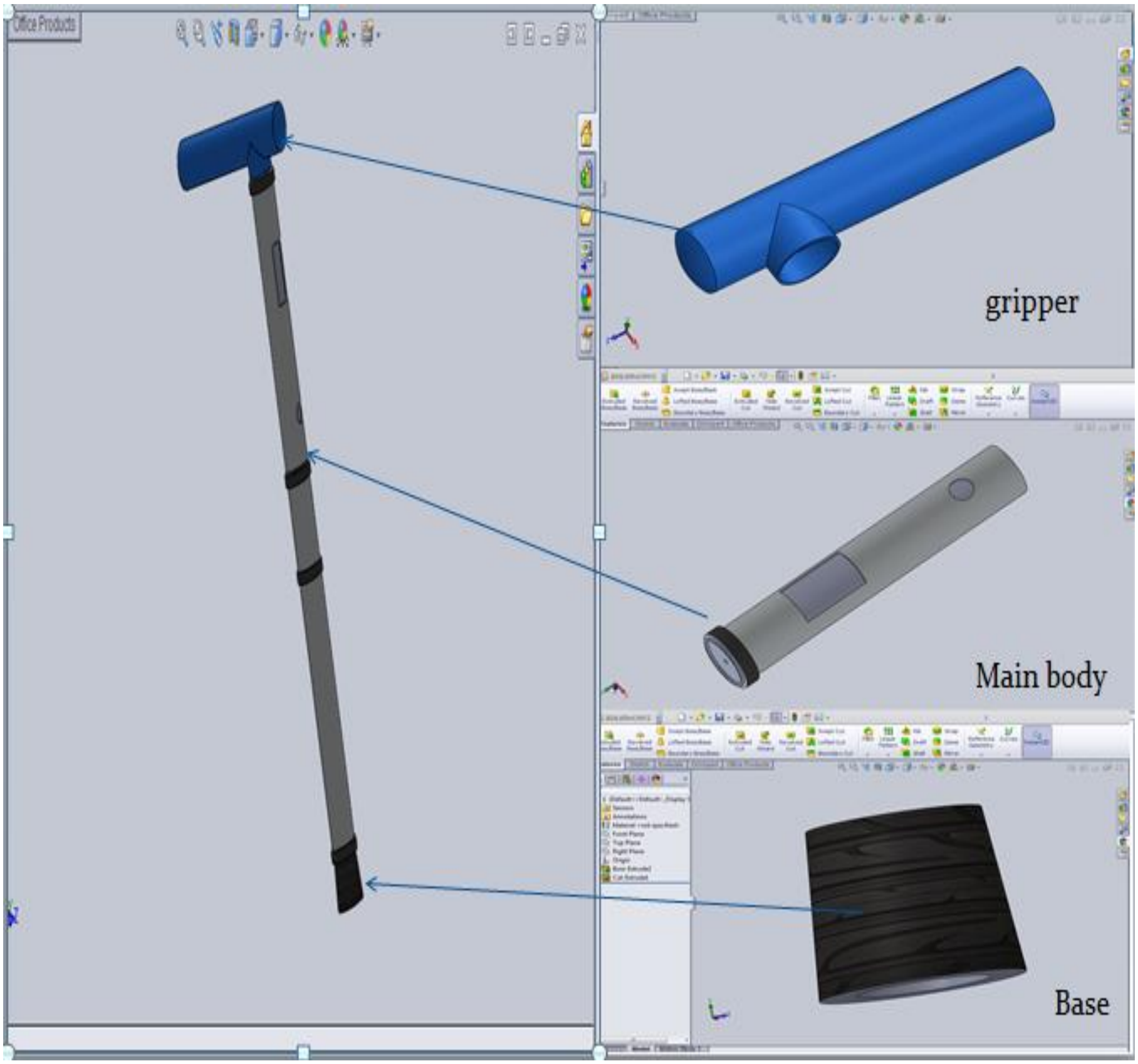


Fig 3.11

DESIGN (2):

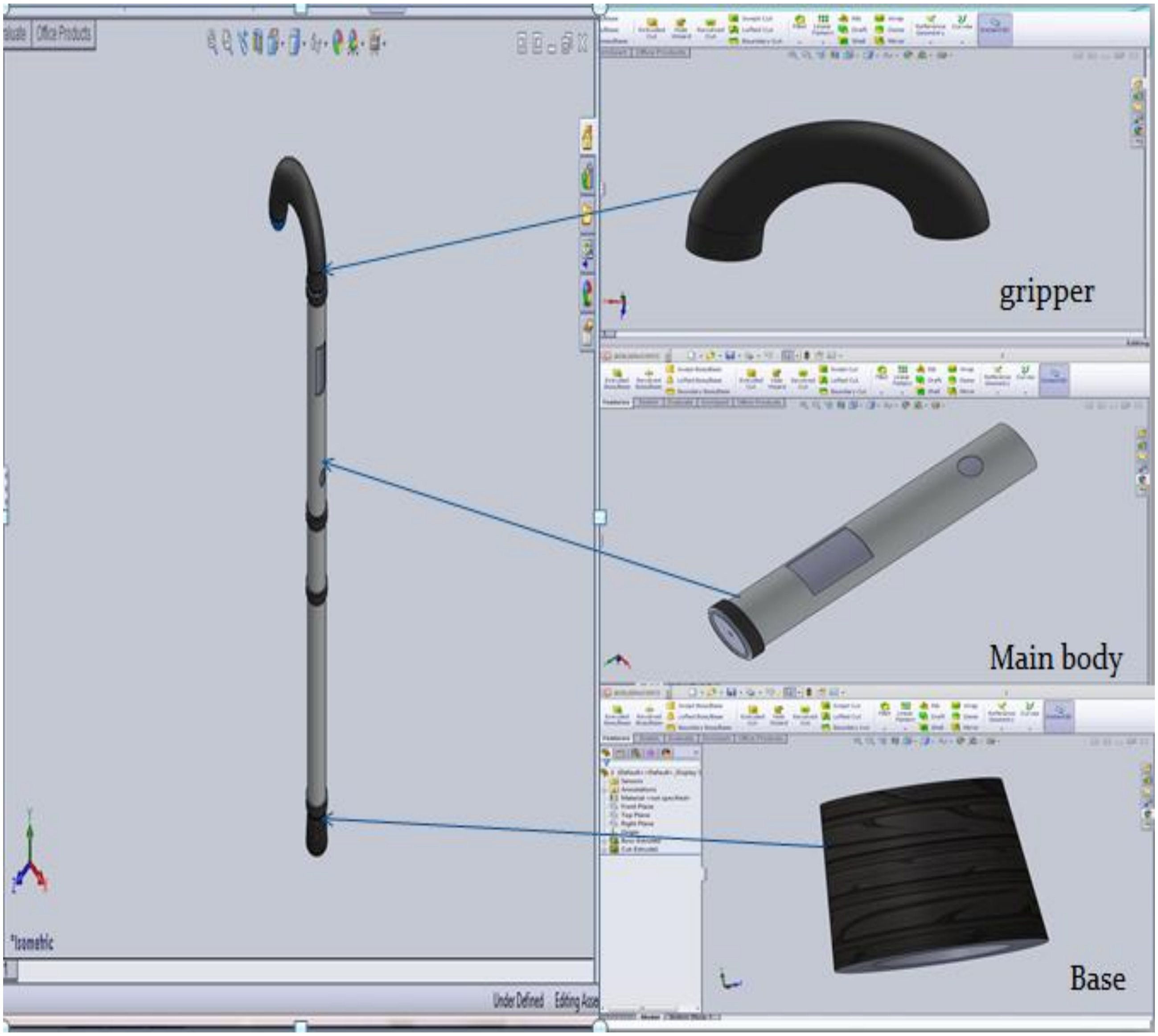


Fig 3.12

DESIGN (3):

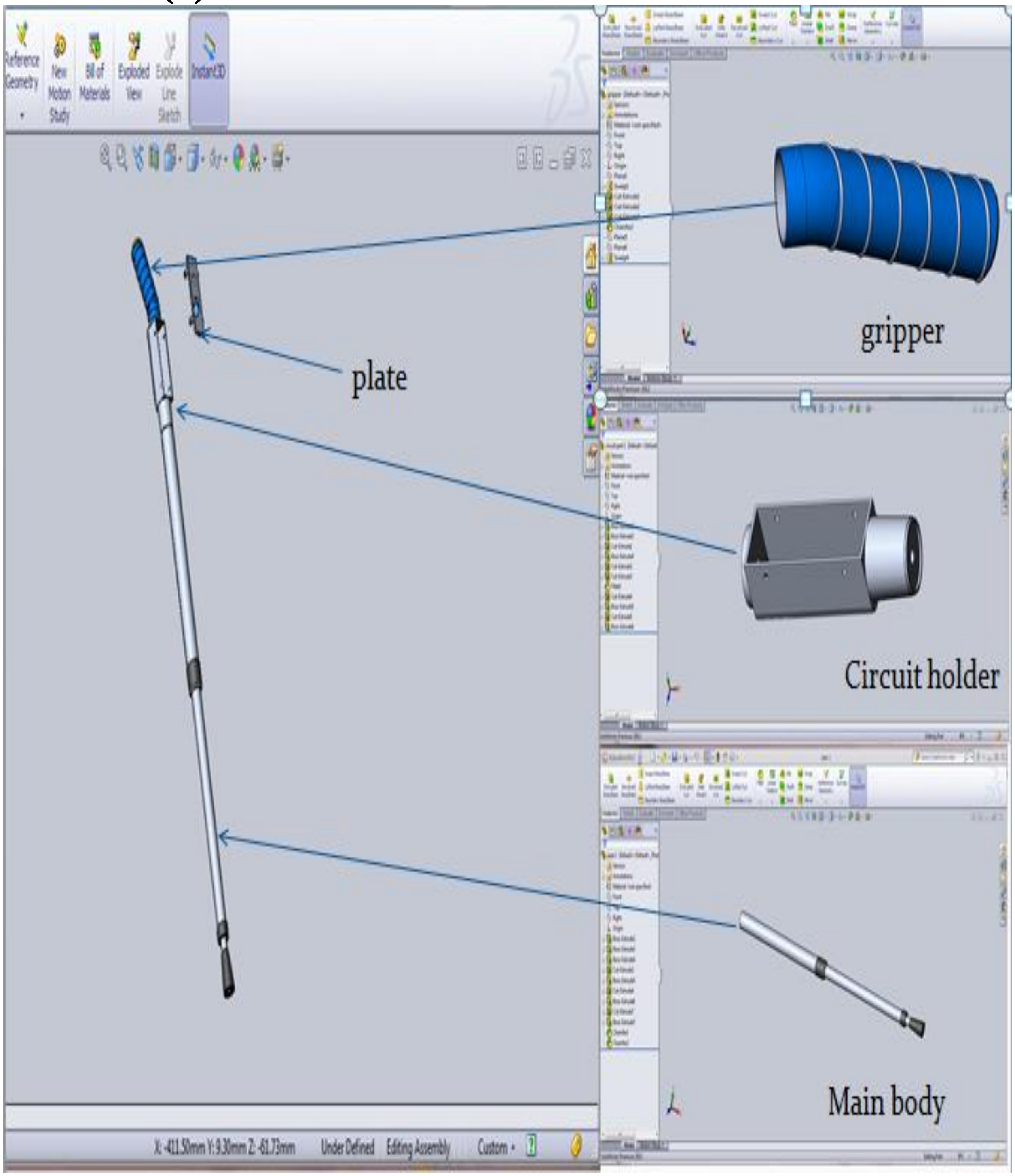


Fig 3.13

3.7) MEDICATED GRIPPER:

The additional feature added to the intelligent stick is a special medicated rubber gripper that will help to stimulate the nerves of hand. The main nerves of the hand are the radial nerve, the median nerve, and the ulnar nerve. Each nerve gives movement and feeling to different areas of the hand as shown in fig3.5(a).

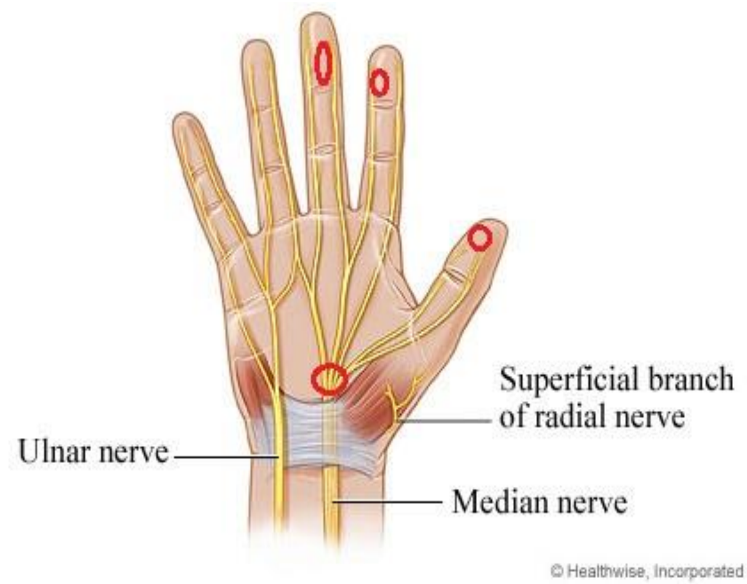
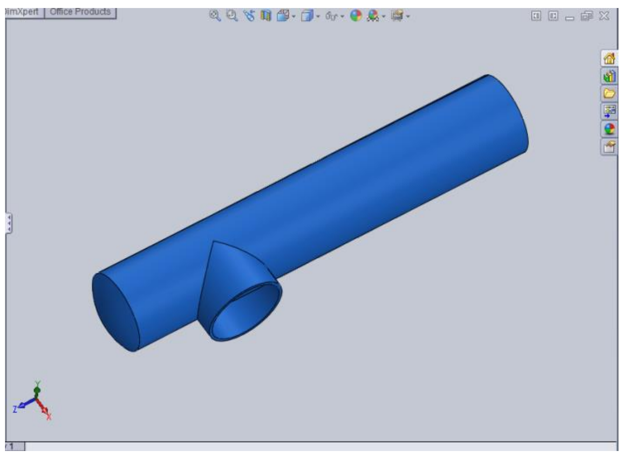


Fig 3.14 (a).

When peripheral nerves become repeatedly or continuously compressed or entrapped by other structures near them, nerve damage can occur. Such entrapment is the cause of Carpal Tunnel Syndrome, Cubital Tunnel Syndrome, Meralgia Paresthetica, Tarsal Tunnel Syndrome and Other Entrapments. Distal median nerve dysfunction is a form of peripheral neuropathy that affects the movement of or sensation in the hands. Dysfunction of one nerve group, such as the distal median nerve, is called a mononeuropathy. Mononeuropathy means there is a local cause of the nerve damage, although occasionally body-wide (systemic) disorders may cause isolated nerve damage.

Distal median nerve dysfunction occurs when the nerve is inflamed, trapped, or injured by trauma. The most common reason is trapping (entrapment), which puts pressure on the nerve where it passes through a narrow area. Wrist fractures may injure the median nerve directly or may increase the risk for trapping a nerve later on. Inflammation of the tendons (tendonitis) or joints (arthritis) can also cause nerve compression.

The gripper will have perforations at specific points according to palm so that it will provide comfortable grip and will reduce pain of median nerve. The red circles show sensitive points on the fig 3.6(a) .



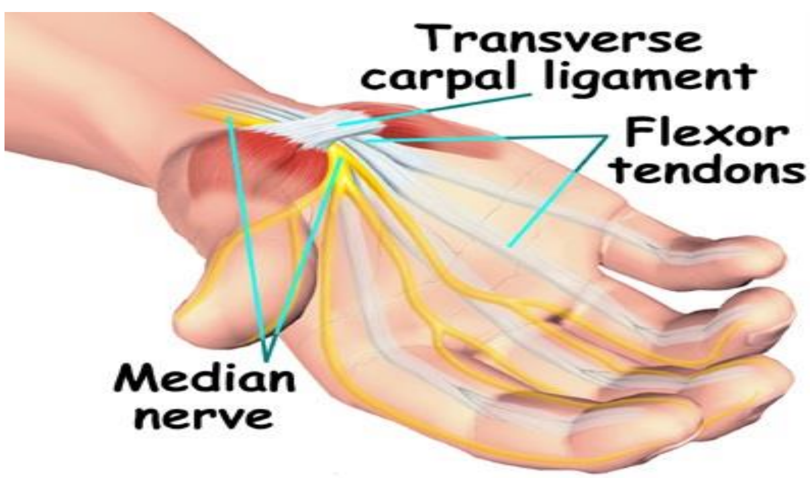


Fig 3.14(b)Hand Gripper

CHAPTER 4

SIMULATION RESULTS:

4.1) STRESS ANALYSIS:

DESIGN (1)

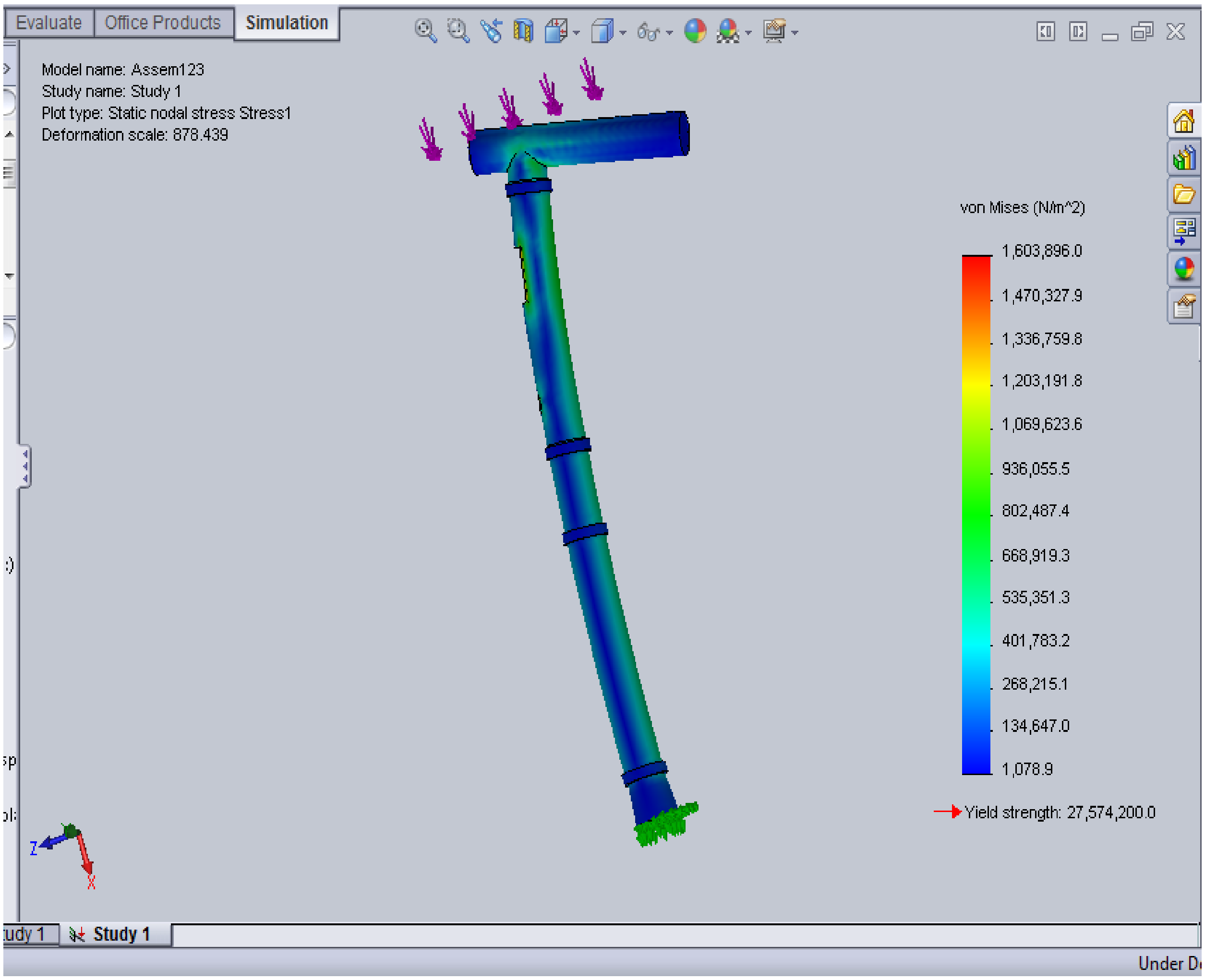


Fig 4.1(a)

DESIGN (2)

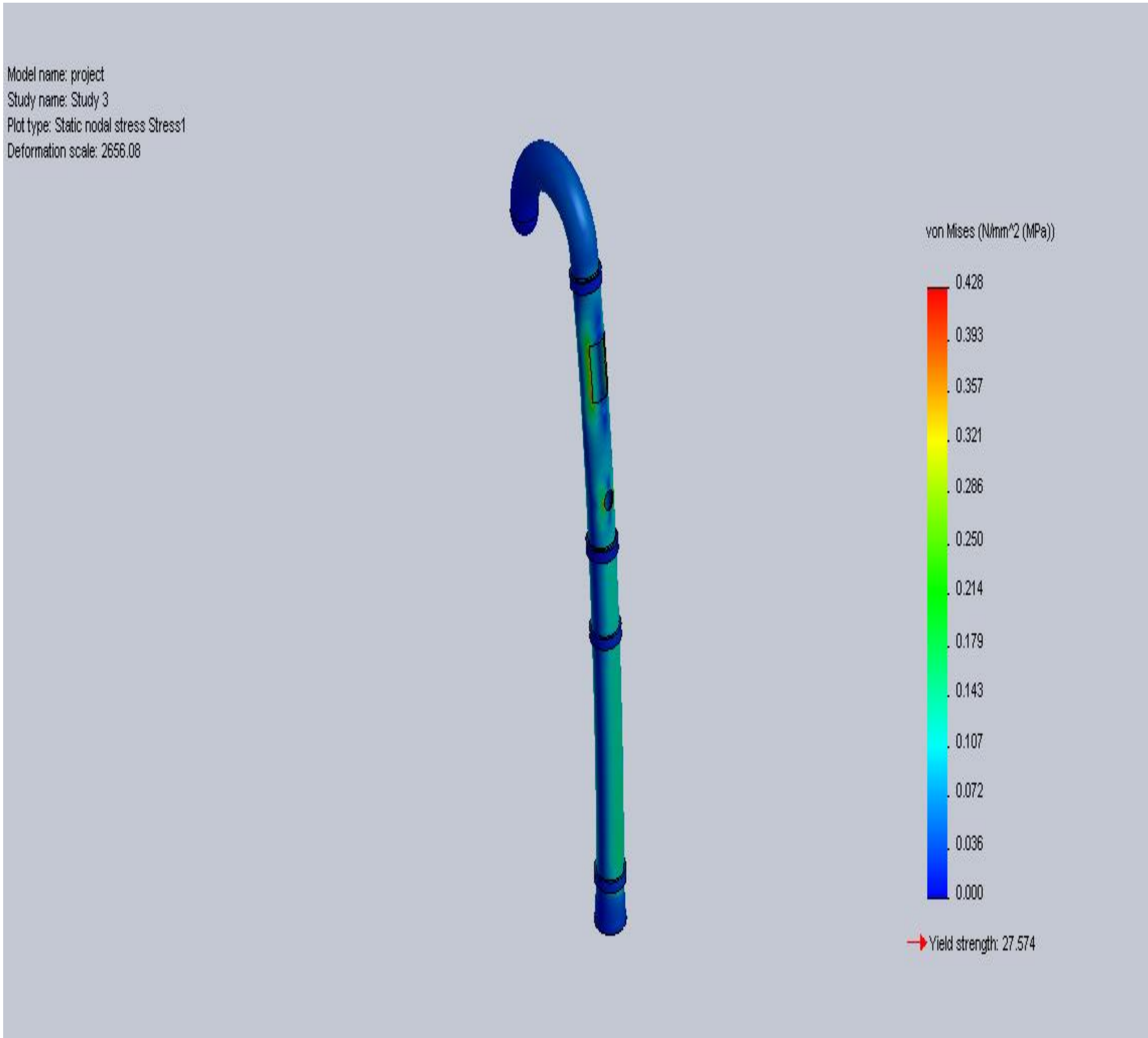


Fig 4.1(b)

DESIGN (3)

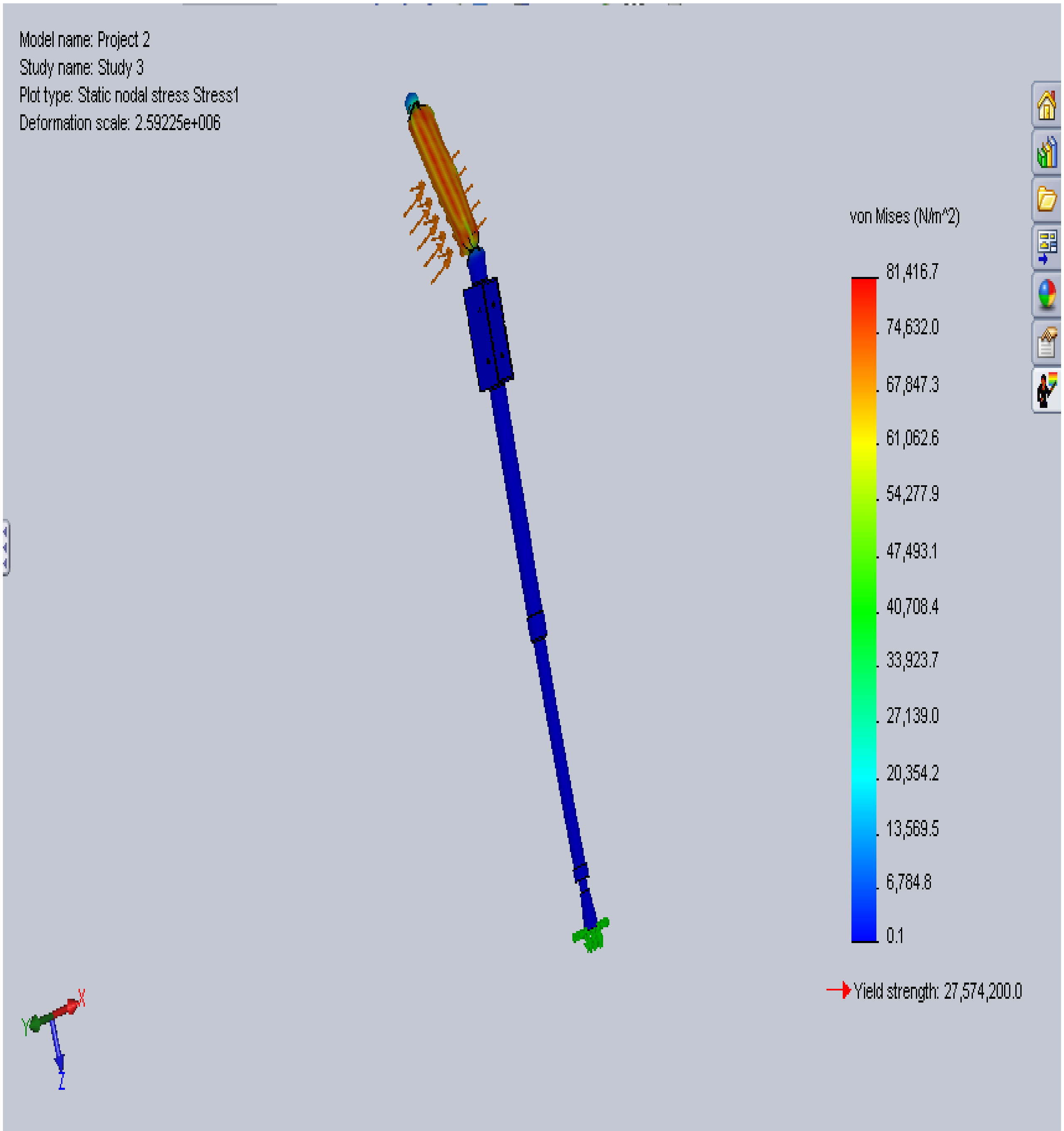


Fig 4.1(c)

Design (3) has more stresses on it than design (1) and design(2).

4.2) STRAIN ANALYSIS:

DESIGN (1)

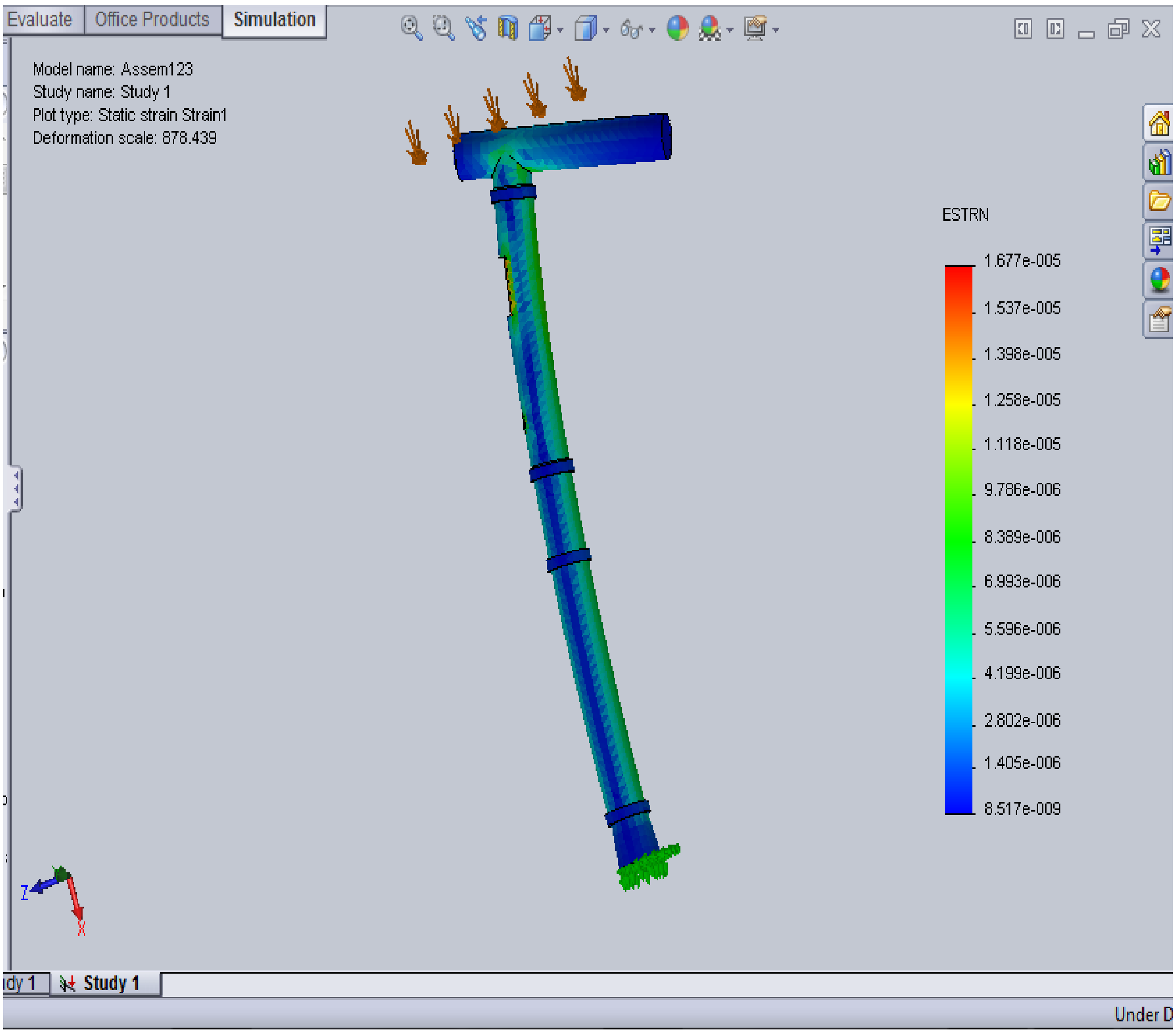


Fig 4.2(a)

DESIGN (2)

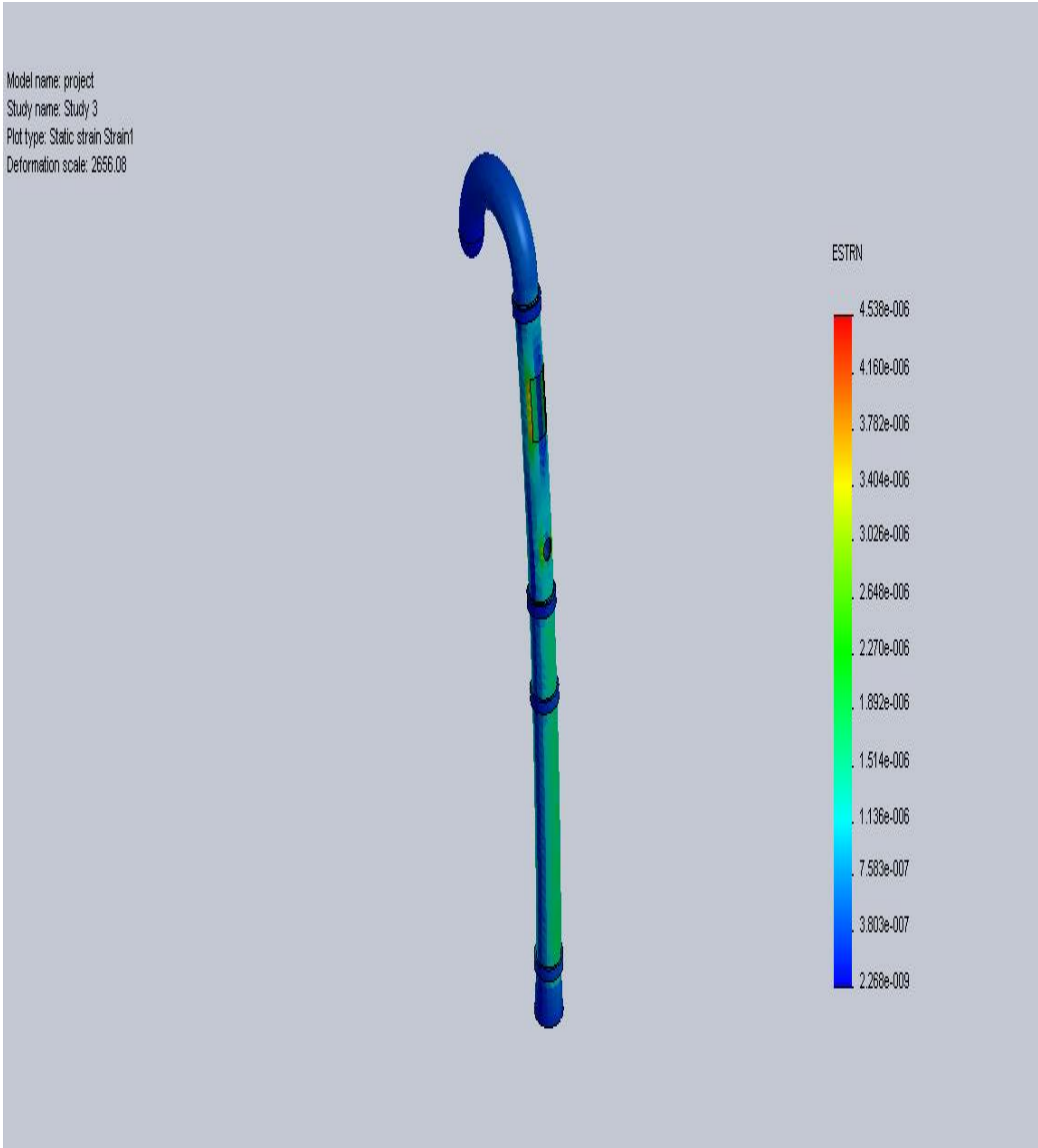


Fig 4.2(b)

DESIGN (3)

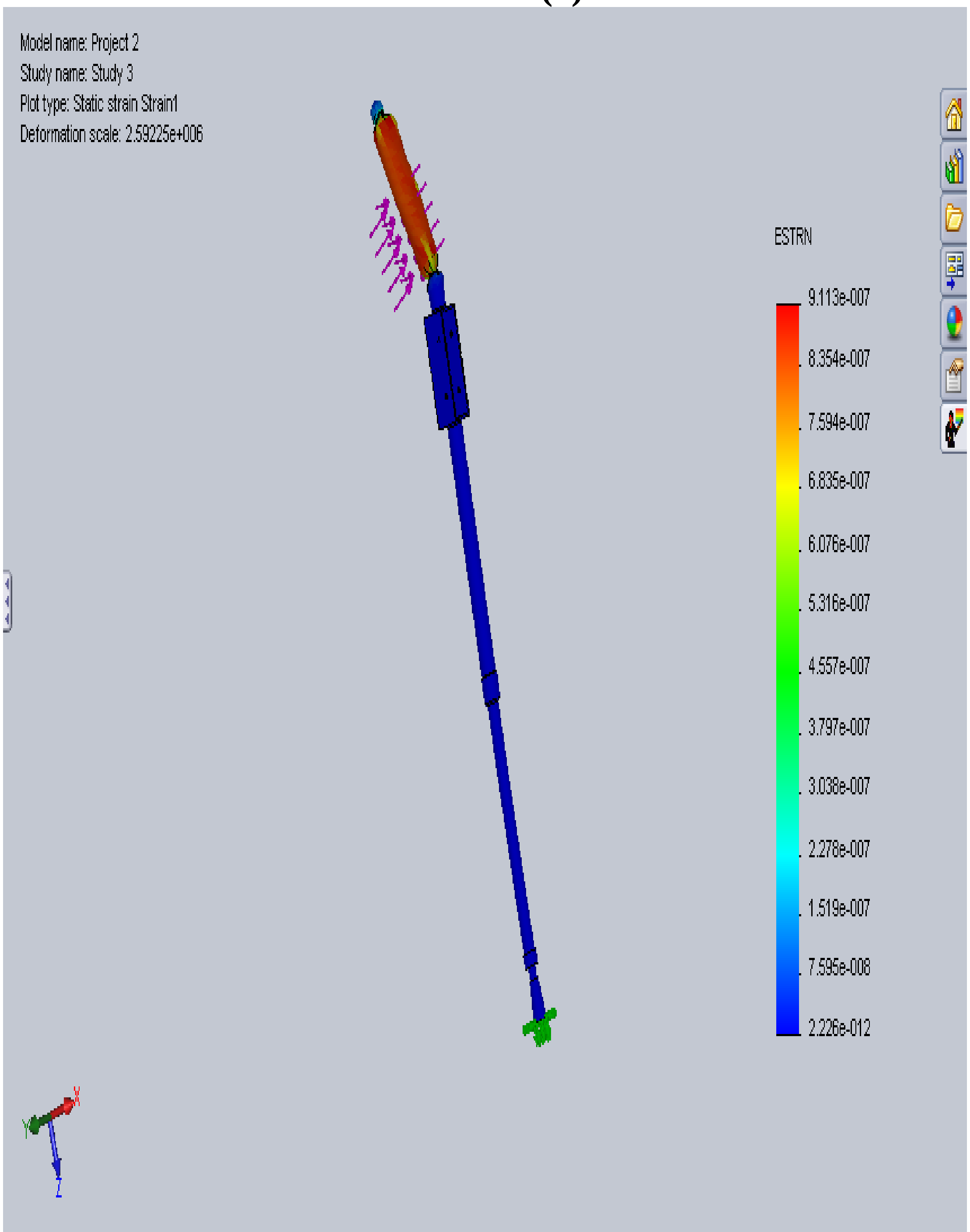


Fig 4.2(c)

Design (2) has more strain on it than design (1) and design(2).

4.3) STATIC DISPLACEMENT:

DESIGN (1)

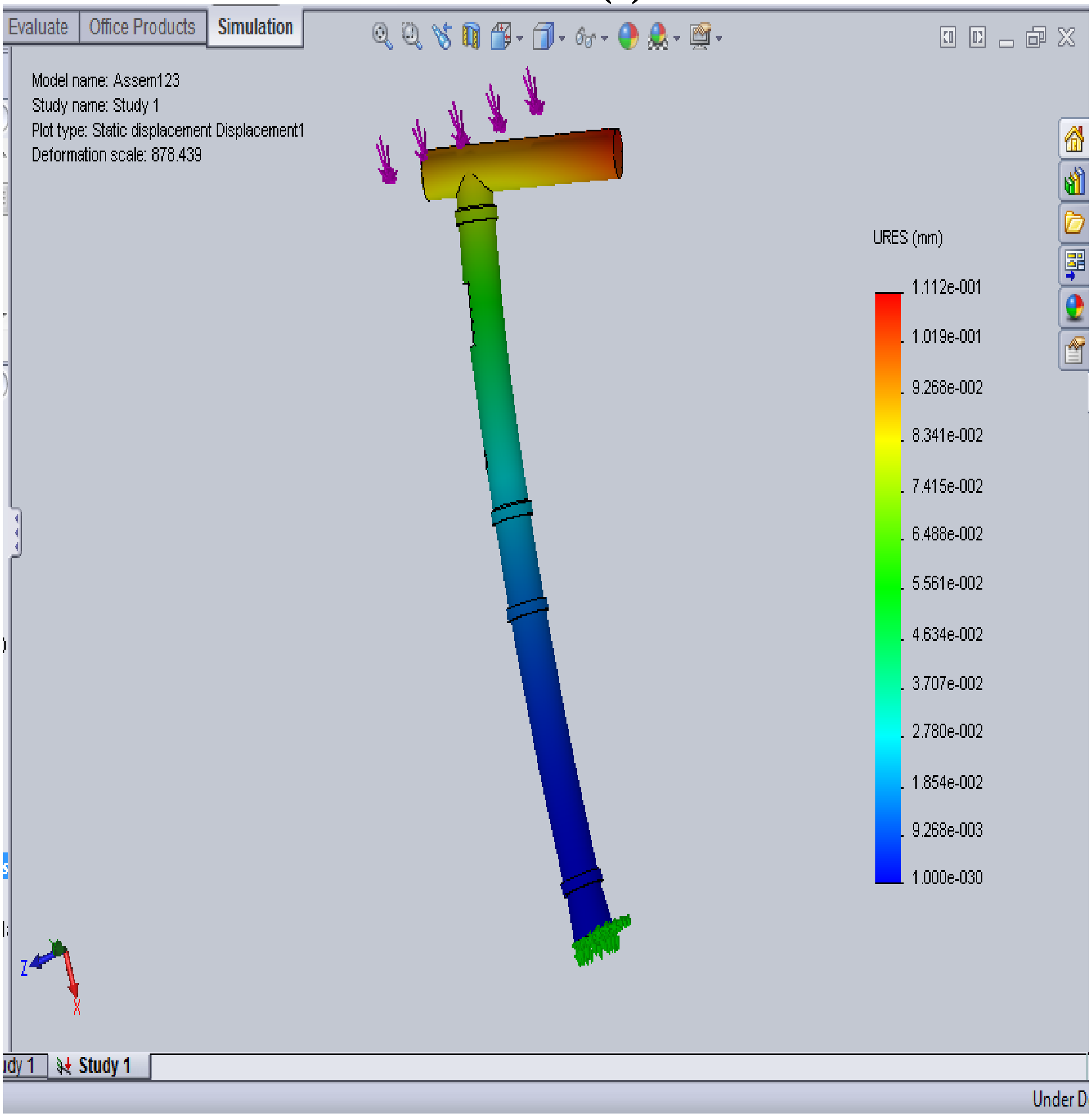


Fig 4.3(a)

DESIGN (2)

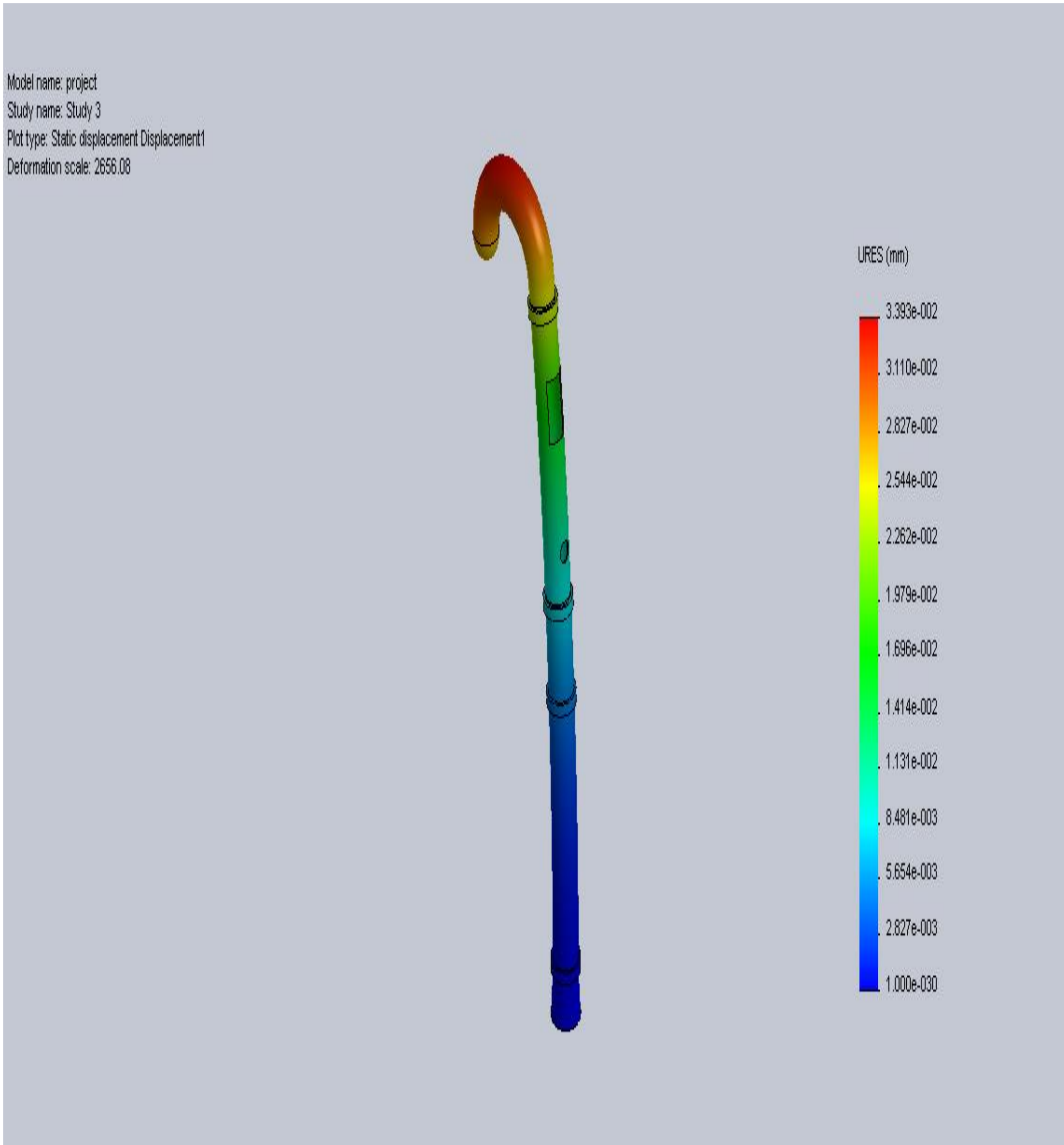


Fig 4.3(b)

DESIGN (3)

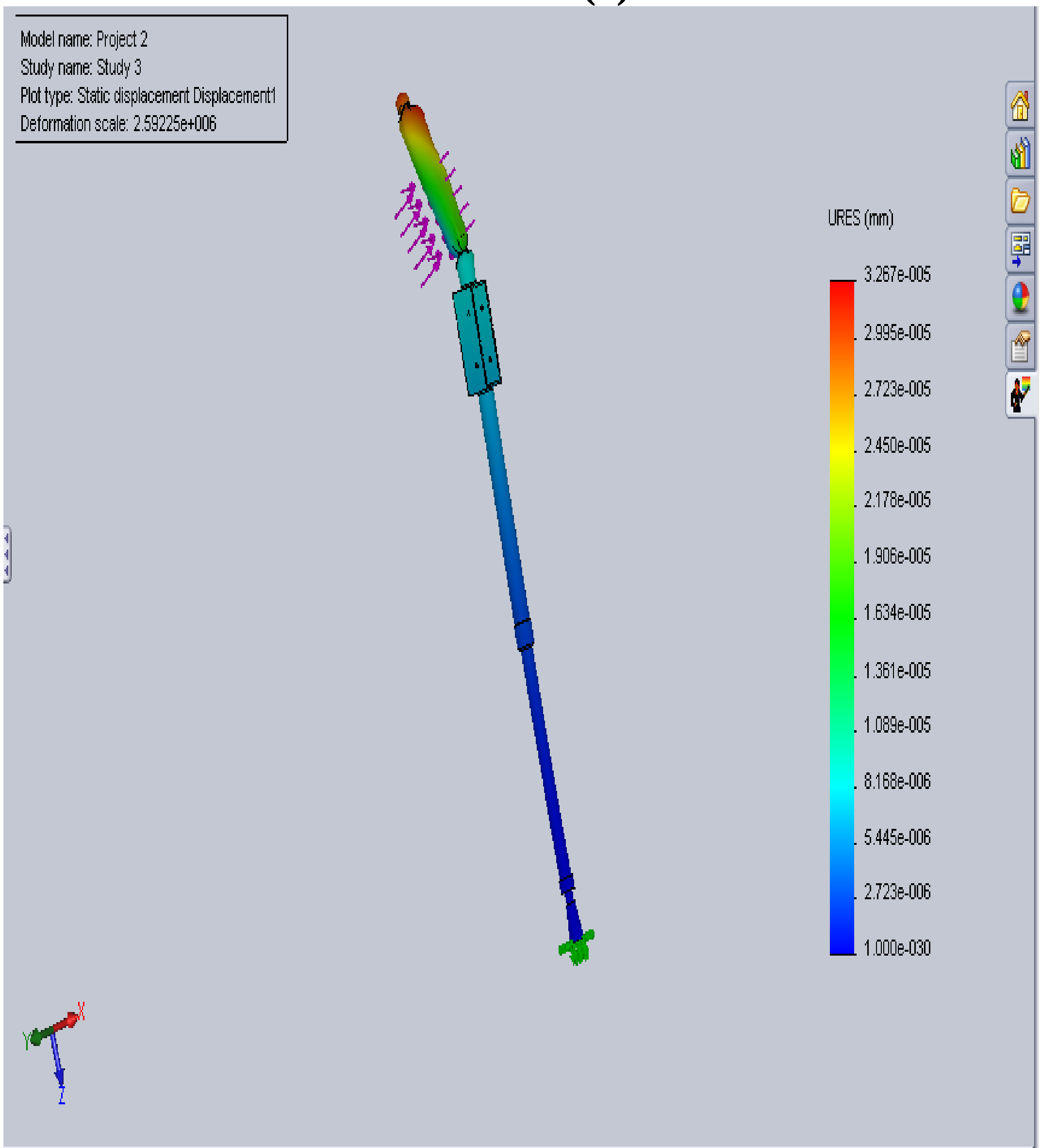


Fig 4.3(c)

Design (3) is more displaced than design (1) and design(2) we can see definite buckling of the design (2) at handle.

4.4) DESIGN SELECTION:

Design (1) is cost effective and also stronger than other designs. It can also provide support to the user. While Design (3) is light in weight and easy to carry but can only be used for guidance due to its strength limitations. It is much expensive. Design (1) and (2) have almost equivalent strength but we considered design(1) as it is practically easy to fabricate and is simple in design and assembly.

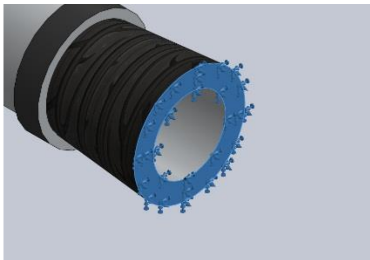
From the analysis it is found that along with other criterion, design (1) has a high factor of safety as to the other ones under equal amount of force applied over it. So design (1) is considered for final selection.

Design (1)

Fig 4.4

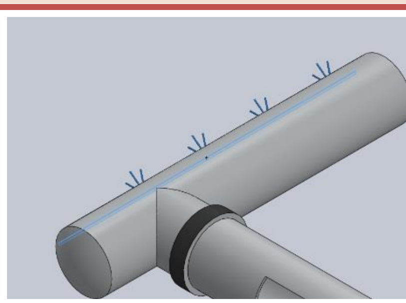
SELECTED DESIGN(1):

Loads and Fixtures

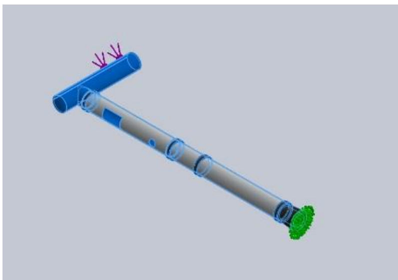
Fixture name	Fixture Image	Fixture Details
Fixed-1		**Entities:** 1 face(s) **Type:** Fixed Geometry

Resultant Forces

Components	X	Y	Z	Resultant
Reaction force(N)	-23.6974	0.15914	0.00103813	23.698
Reaction Moment(N-m)	0	0	0	0

Load name	Load Image	Load Details
Force-1		**Entities:** 1 face(s) **Type:** Apply normal force **Value:** 40 N

Material Properties

Model Reference	Properties	Components
	Name: **1060 Alloy** Model type: **Linear Elastic Isotropic** Default failure criterion: **Max von Mises Stress** Yield strength: **2.75742e+007 N/m^2** Tensile strength: **6.89356e+007 N/m^2** Elastic modulus: **6.9e+010 N/m^2** Poisson's ratio: **0.33** Mass density: **2700 kg/m^3** Shear modulus: **2.7e+010 N/m^2** Thermal expansion coefficient: **2.4e-005 /Kelvin**	**Solid Body 1(Boss-Extrude5)(987-1),** **Solid Body 1(Cut-Extrude1)(project-1/1-1),** **Solid Body 1(Boss-Extrude3)(project-1/3-1),** **Solid Body 1(Boss-Extrude6)(project-1/5-1)**
Curve Data:N/A		

Mesh Information:

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	11.6563 mm
Tolerance	0.582816 mm
Mesh Quality	High
Remesh failed parts with incompatible mesh	On

Mesh Information – Details:

Total Nodes	19357
Total Elements	9890
Maximum Aspect Ratio	32.993
% of elements with Aspect Ratio < 3	20.2
% of elements with Aspect Ratio > 10	2.21
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:06
Computer name:	user

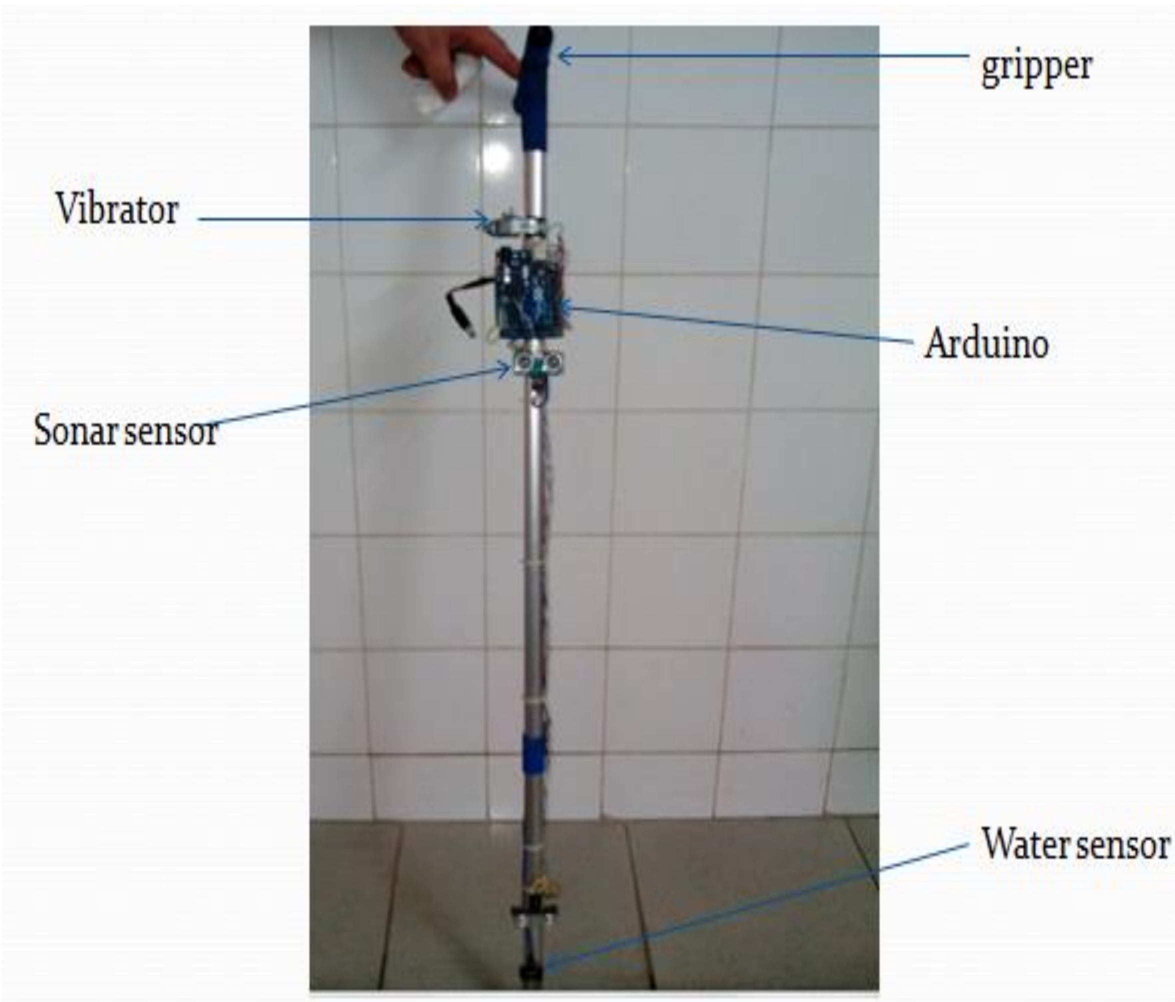
Resultant Forces

Reaction Forces

Selection set	Units	Sum X	Sum Y	Sum Z	Resultant
Entire Model	N	-23.6974	0.15914	0.00103813	23.698

CHAPTER 5

5.1)FABRICATED MODEL:



Fig(5.1)

CIRCUIT MODEL:

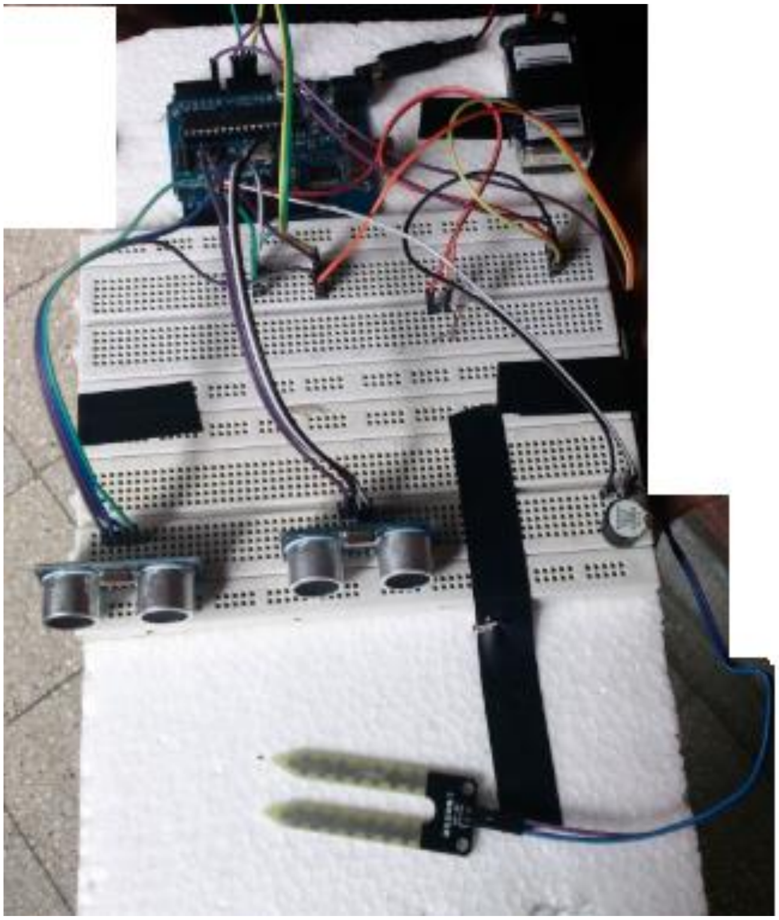


Fig 5.2 (breadboard design)

5.2) PROGRAM EXPLANATION:

The full program is given in “APPENDIX-1”

- First all the pins from the sensors to arduino and from arduino to the output devices including vibrator and buzzer are defined.
- Next the moisture level for water sensor reading was set to constant value of 700 in the program.
- In the next step the loop is used which contains the formulas for working of the devices.
- Then the main step is to define the conditions using if else statement for all the sensors.
- The primary sonar sensor works for distance less than 1m.
- The second sensor works for ditch/hole condition when distance is more than 80cm from the bottom.
- Finally water sensor senses moisture when its level is less than 700 set value in the start condition.
- The delay is 0.1 seconds.

5.3)WORKING PRINCIPLE:

As we are using both vibrator and buzzer as a detector so we need to have a specific arrangement for working of each output function to nullify the confusion that can be faced by the blind person.

- When any obstacle is detected, the microcontroller sends a signal and the buzzer is turned “on”.
- When water comes in contact with the bottom of the stick containing water sensor, both buzzer and vibrator are turned “on”.

- When a trench(hole/ pit/ditch) comes in the way the arduino sends a signal to the H-Bridge and the vibrator is turned on.

STAIRS DETECTION MECHANISM:

In addition to the primary microcontroller that is used for obstacle detection, a second sonar sensor is used at the bottom of the stick facing towards ground and inclined at nearly 10 to 15 degrees is used for stairs and holes detection .

The range is set to almost 1.5 feet and if the distance of the waves become more than the set distance then the sonar sensor detects any hole or stairs in the way sending signal to the vibrator through arduino.

As the fig(5.3) shows when the person approaches any low surface like stairs the signal will be send. This principle can be easily understood from the figure considering the increase of distance from the bottom of the stick which allows the blind person to sense any hole in front of him on the way.

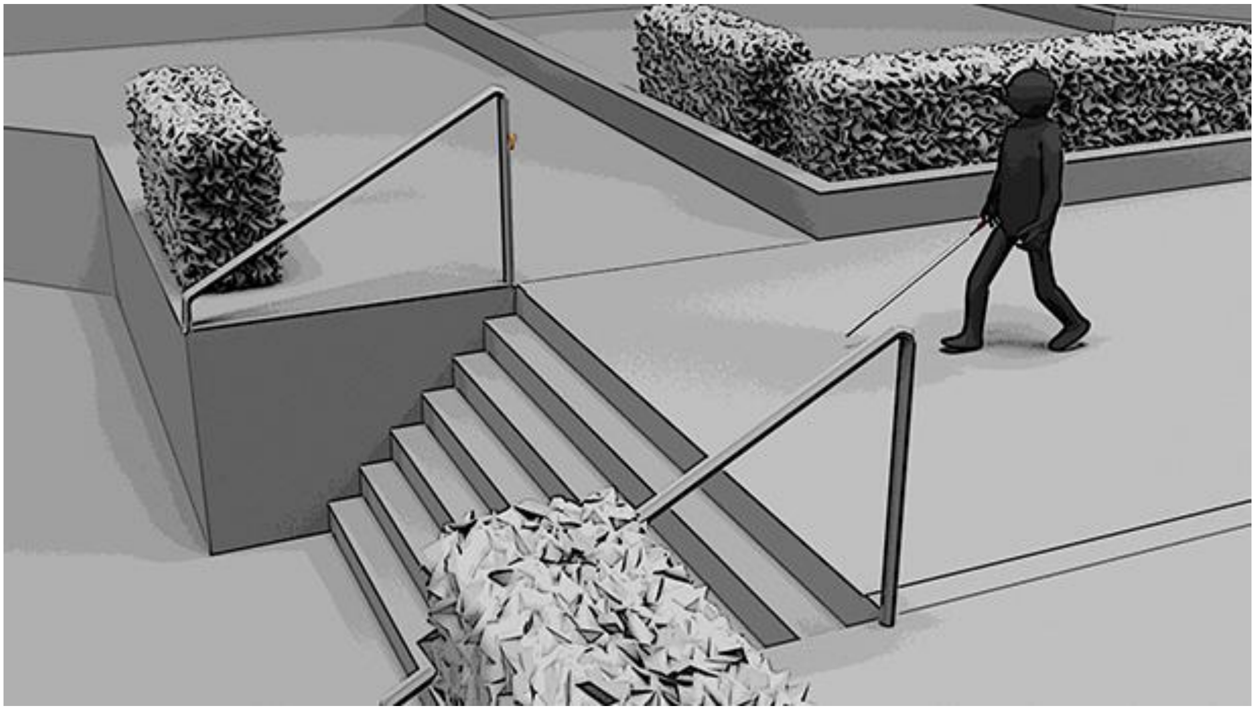


Fig 5.3

CHAPTER 6

6.1)MODIFICATIONS:

- Instead of using sonar sensor laser sensor can be used for stairs detection more accurately and effectively. The LIDAR-Lite is a high-performance distance sensor that costs a fraction of what a sensor with comparable performance would usually cost. This sensor has a range of 40 meters and uses some very clever innovations to attempt to imitate the performance of much more expensive “Time of Flight" distance sensors. Lasers are dangerous and can damage the eyes. if children are using this instruct able ensure they are supervised by a responsible adult at all times.

- Nano components can be used to improve design. The nanomaterials field includes subfields which develop or study materials having unique properties arising from their nanoscale dimensions. Development of applications incorporating semiconductor nanoparticles to be used in the next generation of products, such as display technology, lighting, solar cells and biological imaging. Materials reduced to the nanoscale can show different properties compared to what they exhibit on a macroscale, enabling unique applications. For instance, opaque substances can become transparent; stable materials can turn combustible (aluminum); insoluble materials may become soluble . A material such as gold, which is chemically inert at normal scales, can serve as a potent chemical catalyst at Nano scales. Much of the fascination with nanotechnology stems from these quantum and surface phenomena that matter exhibits at the Nano scale.

- GPS can also be installed as a guidance tool. A new thought of developing an intelligent stick equipped with GPS navigation system, which detect the obstacles in path and gives information about their location using GPS coordinates. The combination of ultrasonic sensors and GPS will detect the obstacles and determine the position and will gives information about location through Bluetooth. The location of the blind is found using Global System for Mobile communications (GSM) and Global Position System (GPS). This system helps the visually impaired people solve many problems such as the person can leave home by themselves in a safe and convenient way, participate in more social functions and other activities to provide more convenient means and improve their quality of life.

- Modification in the design can also be made by using latest technologies and by applying additional advanced functions to the design on hand. This will help in further research work on the topic

6.2) CONCLUSIONS:

The ultrasonic sensors in the stick sense surrounding and detect the obstacles. The person was informed through vibrator and a beep sound of buzzer. The specific area was programed for determining position. It provided location on the spot. In our hardware representation everything is embedded in a light weight circuit. The stick is relatively low cost easily affordable and portable, Light weight, and provide safety, support and location. No training is required. Our proposed methodology given a new opening for and expand the area of operation for the visually impaired person by taking outside world as functional area. Before this the blind person was bound to his building premises only. Our idea removes this restriction on him.

The medicated gripper mechanism will provide an additional health effective function to the intelligent stick.
As the designing part has been completed successfully and we practically manufactured the intelligent stick in the workshop.Aluminium pipes are used as the material and various operations like cutting, grooving, slotting and grinding were carried out to give the required shape to the design. Also the circuit is to fitted on the stick for providing complete design of intelligent stick.

In the times of overcoming limitations and of running socially responsible businesses the product is directed mainly to local authorities, managers of public utility buildings , schools, universities, public transport companies,

construction & maintenance companies and many other responsible for public areas.
Experimental Analysis has been done on the final design to see its practical viability to user and environment. This gave a perfect design for final presentation or practical application.

Local agencies responsible for regional promotion may be also interested in it when considering care for regional development and tourism.The system is also good solution for socially involved business. The experimental results have shown the usefulness of the system in allowing blind people to move independently, safely and quickly among obstacles and hazardous places. The experimental results have shown the usefulness of the system in allowing blind people to move independently, safely and quickly among obstacles and hazardous places.

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- [2] Sung Jae Kang, Young Ho, Kim, In Hyuk Moon, May2001 IEEE "Development of an Intelligent Guide-Stick for the Blind".
- [3] João José, Miguel Farrajota, João M.F. Rodrigues, J.M. Hans du Buf,May 2011"The Smart Vision Local Navigation Aid for Blind and Visually Impaired Persons".
- [3] Srirama Divya,B. Navya, P.Suma,2010"Ultrasonic and voice based walking stick for the blind".
- [4] Naseer Muhammad, Engr.Qazi Waqar Ali, Dec 2012 "Design of Intelligent Stick Based on Microcontroller with GPS Using Speech IC".
- [5] www.wehealny.org.

APPENDIX-1

ARDUINO PROGRAM:

```
#define trigPin 3
#define echoPin 2
#define led 11
#define trigPin1 8
#define echoPin1 7
#define led1 4
const int VAL_PROBE = 0; // Analog pin 0
const int MOISTURE_LEVEL = 700; //the value after the LED goes ON

int sound = 250;

void setup() {
Serial.begin (9600);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(led, OUTPUT);
pinMode(trigPin1, OUTPUT);
pinMode(echoPin1, INPUT);
pinMode(led1, OUTPUT);
}

void loop() {
  long duration, distance;
  long duration1, distance1;
  int moisture = analogRead(VAL_PROBE);
  digitalWrite(trigPin, LOW);
```

```
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration/2) / 29.1;
  digitalWrite(trigPin1, LOW);
delayMicroseconds(2);
  digitalWrite(trigPin1, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin1, LOW);
  duration1 = pulseIn(echoPin1, HIGH);
  distance1 = (duration1/2) / 29.1;

  if (distance <= 100) {
    digitalWrite(led, HIGH);
   sound = 250;
}
  else {
    digitalWrite(led,LOW);
  }
    if(distance1 >=80)
  {
    digitalWrite(led1, HIGH);
  }
  else {
    digitalWrite(led1,LOW);
  }

  if (distance > 100 || distance <= 0){
    Serial.println("Out of range");
```

```
}
else {
  Serial.print(distance);
  Serial.println(" cm");
}
delay(500);
if (distance1 < 15 || distance1 >= 30){
  Serial.println("Out of range");
}
else {
  Serial.print(distance1);
  Serial.println(" cm");
}
Serial.println(moisture);
  if(moisture < MOISTURE_LEVEL) {
  digitalWrite(led, HIGH);
  digitalWrite(led1, HIGH);
  } else {
  digitalWrite(led, LOW);
   digitalWrite(led1, LOW);
  }
  delay(100);
  }
```