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Depth and Torque Controlled Screw Tightning Machine

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ABSTRACT:Screw-tighteningisanimportantassignmentin assemblyprocessesduetotheirwideapplicationin varioustypesofmanufacturedproducts.Forexample,a boutthreemillionscrewsare usedina plane,andaboutthreethousandscrewsareusedinanord inarycar. AccordingtoOgushietal. (2015)inalmostallpreciseelectricalandmechanicalpa rts,handtorquescrewdriversare used forthe fasteningcontrolof screws.
Inanykindofproductionprocess,notonly taskshouldbe properlydesignedbutalsothe measurementsystemshouldbe properly implemented tokeepa goodproductqualityandan efficientflow also.Anaccurate measurementof externalforcesisalsoimportantinmanipulation tasksinvolving tool-usage,thefasteningtorqueandtheangulardisplacemen toftheScrewhave tobecloselymonitored. The accuracyofmeasurementsystemislowerthanthatofass embly designtakesplace. Currently, industriesare stillusinghandtorque, screw driversareusedfor the fasteningcontrolofscrewsandtorquetraceabilityisalm ostnon-existent. Allthehanddrivengun availablearebasedontorque butnoneofthesedependsonthedepthup towhichscrew needsto betighten irrespective ofthe defects in holes.

Keywords: Screw driving machine ,depth sensor , torque controlled .

I. INTRODUCTION

Allthescrewtighteningtorque machineavailable inthemarketorindustriestightenthe screwtospecific limitonapplyingspecific torquebuttheworker doesnotknowsthedepth up towhichthe screw hasreachedhence sometimes the screw doesnotreachesup tothe desiredlimitandhence failure occursinjoints.Soif wemakeamechanismbywhichwe cantightenascrewtoourowndesireddepthitwouldhelp ustoovercomeallthefailures. The screwtighteningmachineavailableinthemarketareoft hreetypeshydraulic, pneumaticand electrical. Our projectisfocusingon onlyelectricalgunsbecause itis cheap andcan be carriedfromoneplaceto another. Ifwecancontrolthemechanism inasuchawaythatonce thescrewreachesthespecifieddepththegunshouldstop atthatpointhencethiswould ultimately lead topropertightening ofscrewandfailureswould get minimized

1.PROBLEM STATEMENT

Screwtighteningmachinetightensthescrewt ospecific limitona specific torque butif holes are porous or blowhole is present then the screwdoes not tightens tothe desired limit and alsothe screw doesnot reachesdesireddepth.Soour mainaimistotighten the screw uptoour owndesireddepthirrespectiveofdefects (errors)intheholesandthemechanismstopsassoon as the desired depth is reached.

2.OBJECTIVE

- To identify the necklace needed for tensing screws on different accoutrements eg plastic, sword, ironetc.
- To identify the different types of failures that are possible when applying necklace eg. fatigue failure, thread stripping.
- Effect of Lubrication (If a screw is waxed, the disunion in the vestments and under the head is dropped and the relation between tensing necklace and setting force is changed)
- To identify the depth up to which the screw reaches on applying certain necklace without failure (using Ultrasonic detector).
- Main end is that it must be in the hand of driver that up to what depth he wants to strain the screw

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and the medium stops incontinently once it reaches the asked depth.

3.SCOPE OF STUDY

notknowsthedepth uptowhichthescrew hasreachedhence sometimes the screwdoesnotreachesuptothe desired depth due to some errors in the hole and hencefailureoccurs in joints

II. METHODOLOGY

- Inspectionofthreadingdefect in the hole.
- Lubricationofholes.
- Checkingthetorquerequiredtotightenthescrewusingtorquechart fordifferent materials.

- Applyingspecifictorqueto tighten thescrew.
- ManualInspectionto seewhetherthe screw has tighten ornot.
- Inspectionofthe depth upto which screw has reached.

1.THE SCREWJOINT

A screw is exposed to tensile load, to torsion and generally additionally to a shear load.The stress within the screw once the screw has been tightened to the planning extent is thought as pre-stress.The tensile load corresponds to the force that clamps joint members along. External hundreds that arc but clamping force won't modification the tensile load within the screw.On the opposite hand, if the joint is exposed to the next external hundreds than the pre-stress within the bolt the joint can change integrity and also the tensile load within the screw can naturally increase till the screw breaksTorsion within the screw results from friction between threads within the screw and also the nut.Some screws are exposed to shear hundreds that occur once the external force slides the members of the joint in reference to one another perpendicular to the clamping force. in a very properly designed joint external shear force ought to be resisted by the friction between the elements. A joint of this type is termed friction joint. If clamping force isn't adequate to make the friction required, the screw will be exposed to shear load. Joints arc oft designed for acombinationof tensile and shear hundreds.The screw is created of shank and also the head. The shank is rib, either for a part of its length or for the sensible thanks to live the clamping force in traditional production things. Consequently the worth of the clamping force is sometimes mentioned because the adjustment force.As the clamping force could be a linear perform of each the turning angle of the screw and therefore the pitch of the thread, there's an instantaneous relation between the clamping force and therefore the adjustment force at

All the screw tightening torquemachine availablein the market orindustriestighten the screwtospecific limitonapplyingspecific torquebuttheworker does

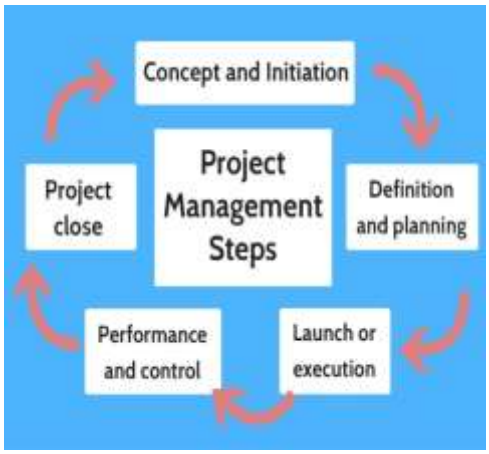

Fig01.Flowchart ofmethodology

total length from the top to go. Longer screws arc sometimes partially rib. there's no have to be compelled to build a thread longer than is critical to tighten the joint as this may build the screw dearer and scale back the strength.The dimensions of threads, the form of the thread and also the pitch, i.e. the space between sequent threads, has been standardized. In apply there arc solely 2 completely different normal used nowadays within the industry; the Unified standard world organisation, originally employed in the Anglo-Saxon countries, and European Metric normal M.

2.CLAMPINGFORCE

In general it's fascinating that the screw is that the weakest member of the joint. Associate in Nursing over-dimensioned screw makes the merchandise each heavier and unnecessarily high-priced.As a regular screw is sometimes relatively cheap it's preferred that the screw ought to be the primary half to interrupt.Furthermore, in most cases the scale of the screw aren't essential for the standard of the joint. what's decisive is that the clamping force, i.e. whether or not it's enough to hold all the load that the joint is meant, and whether or not the joint can stay tight enough to forestall loosening if exposed to pulse hundreds. The problem is that there's no intervals the elastic vary of the screw elongation. However, solely concerning 100% of the force applied is transferred into clamping force.. The remaining adjustment force is consumed in friction within the screw joint – four-hundredth of the force to beat the friction within the thread and five hundredth in friction beneath the screw head.

3.EFFECTOFLUBRICATION

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If a screw is lubricated , the friction within the threads and underneath the top is weakened and also the relation between modification force and clamping force is modified. If a similar force is applied as before lubrication, plenty additional force are remoulded into clamping force. at the worst this would possibly result in the strain within the screw Olympian the strength and breaking of the screw.On the opposite hand, if the screw is totally dry of stuff the clamping force may be too tiny to face up to the forces that the joint is meant, with the danger that the screw becomes loose.

4.MATERIAL SELECTION

MaterialSelection Table

NutMaterial	Dry	LightlyOiled
PhosphorousCoated	0.13-0.24	0.11-0.17
Electro ZincPlated	0.18-0.42	0.13-0.22

Components Required

- Screw Tightening machine(gun)
- Differentsizes of screw
- Depth setter tool.
- Arduino and sensors

5. SCREWQUALITYCLASSIFICATION

When a screw is tightened and also the clamping force starts to create up, the fabric of the screw is stressed. when a brief time once the thread settles the fabric can stretch in proportion to the force. in theory, this elongation can continue till the strain within the screw is adequate the enduringness at that the screw can break. However, as long because the elongation is proportional to the strain the screw can regain its original length once the load is removed. this is often referred to as the elastic space

At a particular stress, referred to as the yield purpose, plastic deformation of the fabric within the screw can occur. However, the screw won't break forthwith. force can still increase however at a lower force rate throughout the deformation on top of the yield purpose. The plastic deformation can lead to a permanent elongation of the screw if the joint is untangled. For terribly correct clamping force necessities this space is typically deliberately nominal for the alteration method. on the far side the plastic space breakage happens.

The material qualities of screws ar standardized, i.e. the quantity of tensile stress they'll be exposed to before the yield purpose is reached and before breakage happens. All screws ought to be marked in line with their Bolt Grade – a classification customary during a two-digit system wherever the primary digit refers to the minimum enduringness in a hundred N/mm2 and also the second digit indicates the relation between the yield purpose and also the minimum enduringness. For example: Bolt Grade eight.8 designates a screw with 800 N/mm2 minimum enduringness and a yield purpose of zero.8 x800 = 640 N/mm2

6.TORQUE AND ANGLE

As we've mentioned on top of, the alteration force is for sensible reasons the standards unremarkably accustomed specify the pre-stress within the screw. The torque, or the instant of force, may be measured either dynamically, once the screw is tightened, or statically, by checking the force with a spanner when alteration. force specifications vary significantly looking on the standard demands of the joint. a security important joint in a very motor automobile, like the wheel suspension, can not be allowed to fail and is consequently subject to terribly demanding tolerance needs. On opposite hand a nut for securing the length of a bench height adjustment screw isn't thought to be important from a clamping force purpose of read and no force demand is also mere. the next level of quality management is reached by adding the alteration angle to the measured parameters. within the elastic space of the screw this will be accustomed verify that each one the members of a joint area unit gift, e.g. that a seal or a washer isn't missing. Also, the screw quality may be verified by mensuration the alteration angle, before cosy level additionally as for final torque-up.In subtle alteration processes the angle also can be accustomed outline the yield purpose and permit alteration into the plastic space of the screw.Knowing the alteration specifications for a screw joint the plain question is; however do you recognize that the joint has been properly tightened force measuring area unit created per one in all 2 principles– static measuring or dynamic measurement. Static measuring means the alteration force is checked when the alteration method has been completed. The measuring is typically done by

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hand with a spanner that has either a spring loaded force scale or a gage electrical device activated instrument. a really common methodology for checking the alteration force is to use a click wrench, that may be a spanner equipped with a clutch which will be pre-adjusted to a selected force. If the force is larger than this force worth the clutch can unharness with a click. If the force is a smaller amount, final torque-up is feasible till the wrench clicks. Over-tightening can not be detected with the press wrench. to live the static force the force worth should be browse instantly because the screw starts to show.An electronic spanner will be used for a a lot of subtle static measuring of the joint. The tool has straingauge force electrical device which supplies a high level of accuracy.

7.ERRORSINTIGHTENING

The main purpose of monitoringthe tighteningtorque istosee that proper clampingforce has reached or not. However, tighteningtorque alone is not ahundred percentguaranteethatthe clamping force is enough forthe loadfor which thejoint is been designed. There areanumberoferrors that might haveoccurred and would have resultininadequatepre-stressinthescrewdespite of thecorrecttighteningtorque.

8.DAMAGEDTHREADS

Damage tothethread orinsufficientlycutthreadswillresultin increase ofresistancetoturning the screwandhence thepredeterminedtorquewillbe reachedbeforethecorrectclampingforce is achieved. Damaged threadscan also bedetected by monitoringthe tightening angle.

9.MISSINGJOINTCOMPONENTS

A commonproblemin the industrialproductionisthatthe operator generally forgetsawasher or packingin theassemblyofa joint.Apart fromhavingotherpurposesfor adesign,missingcomponents willchangethe torquerateof thejointand consequentlyalso theclamping force too.

10.RELAXATION

Alljointssetafter tightening.Thismeansthat aftera shorttime,lessthan30milliseconds andthe clampingforceinthejointisless thanitwaswhenthetighteningstopped.Forjointswhich include an elasticcomponentssuchasgasketsthisrelaxation

canbeconsiderableandasubsequent torque testmayshowthatthetorque isjustafractionof theintendedspecification. Relaxationis usuallyovercomebytighteningintwostages.Apulsetoo lorimpactwrenchmightalsobe a practicalsolutionasthepulsatingdrive alsoallowsrelaxationofthejointbetweenthepulses.

III. MODELING AND ANALYSIS

1.SYSTEMDESIGN

Fluid and Material which are used is presented in this section. Table and Fluid should be in prescribed format

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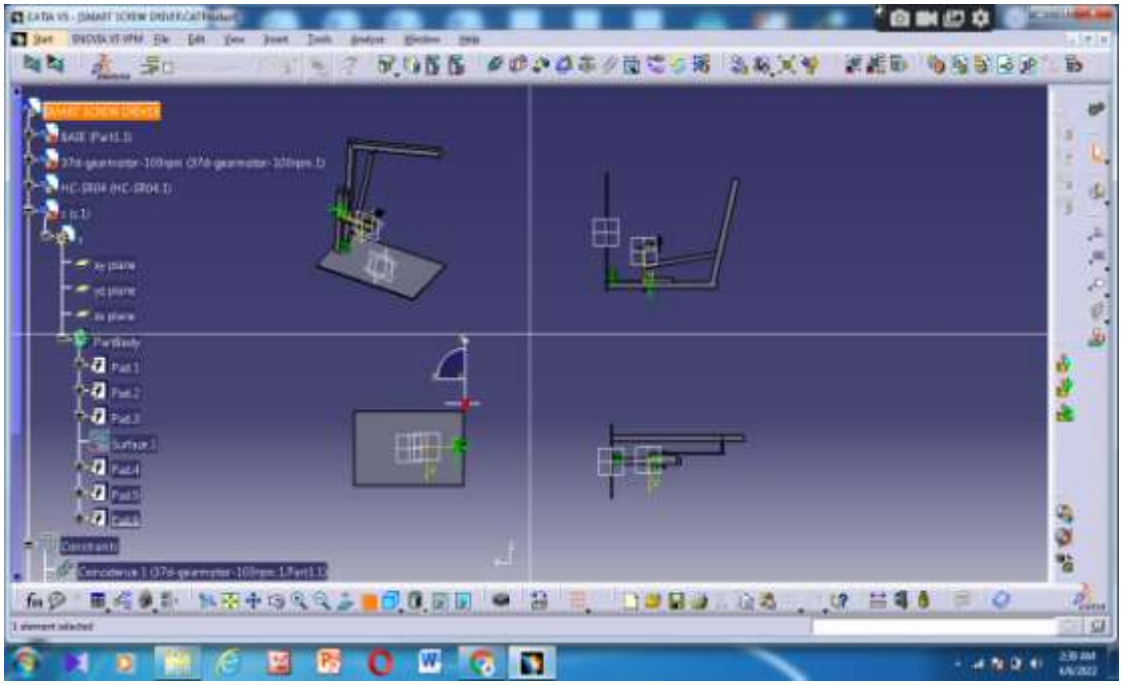

Fig02.All 4 views of 3d cad model

2.MOTOR SELECTION

● First, determine certain features of the design, such as drive mechanism, rough dimensions, distances moved, and positioning period

● Confirm the required specifications for the drive system and for the equipment (stop accuracy, position holding, speed range, operating voltage, resolution, durability, etc.)

● Calculate the value for given load torque,given load inertia, speed, etc. at the motor drive shaft of mechanism. Refer to page 3 for calculating speed,given load torque and load inertia for various mechanisms.

● Select a motor type from AC Motors, Brushless DC Motors or Stepping Motors based on the required type of specifications.

● Make a final determination of the motor after confirming that the specifications of the selected motor/gearhead satisfy all the given requirements (mechanical strength, acceleration time, acceleration torque etc.).

2.1 POWER CALCULATION

Torque = Force X Radius Spur gear

Human force required for rotating the disk = 225 N

Where radius of spur gear r=75 mm

Torque =225 X 75 =16875 N-mm

Johnson 30RPM DC Motor;The vital application of this motor are Pan/ Tilt camera, auto shutter, welding machines, water meter, grill oven, Floor cleaning machine, garbage disposers, household appliances, Slot machines, Money detector, automatic actuator, coffee machine, Towel dispenser, lighting , Coin refund devices, Peristaltic pump and many more .The supply voltage range is 10-12V with the polarity markers at the base of the motor. The overall body of the motor is made up of metal. The motor has a D type shaft with a shaft length of 21mm and diameter of 6mm.

2.2 SPECIFICATION & DETAILS OF MOTOR USED:

1. Rated current (mA): ≤200.
2. Rated power (W): 0.4.
3. Rated Torque (N-cm): 46.7
4. Rated speed: 30 RPM.
5. Shaft length (mm): 21.
6. Shaft diameter (mm): 6.
7. Base motor RPM: 3000.

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Fig03.Motor

Feature Points	Voltage(V)	Current(A)	Input power(W)	Torque (N.m)	Speed(RPM)	Output Power(W)	Efficiency (%)	Time(s)
No Load	12.78	0.041	0.529	0.000	11.0	0.000	0.0	0.000
Eff. max	12.74	0.120	1.527	0.467	8.1	0.396	26.0	25.09
P_{out} max	12.70	0.194	2.463	0.908	5.3	0.508	20.6	37.13
Torque max	12.63	0.337	4.256	1.760	0.0	0.000	0.0	0.000

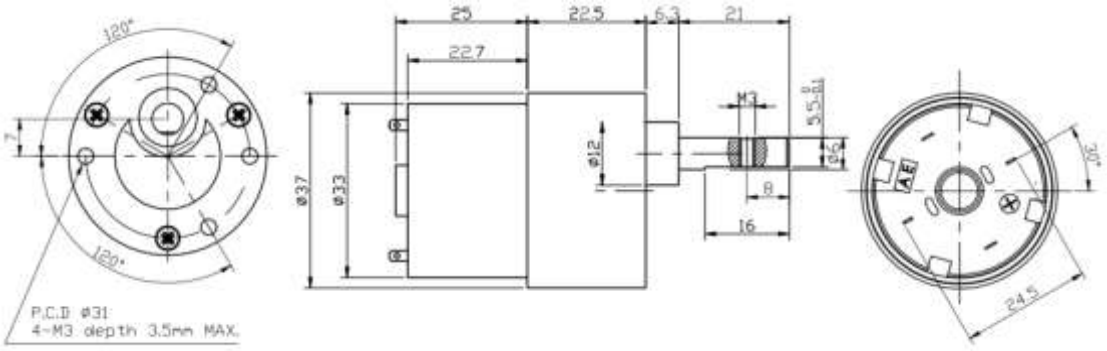

Fig 04. Johnson DC Motor design

2.3 USEOFSENSORTO CONTROLDEPTH

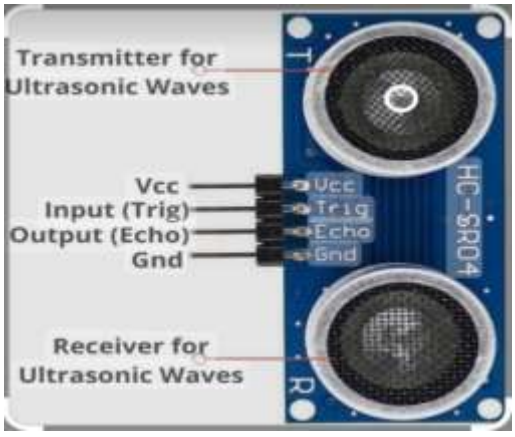

Fig 05. Ultrasonic Sensor

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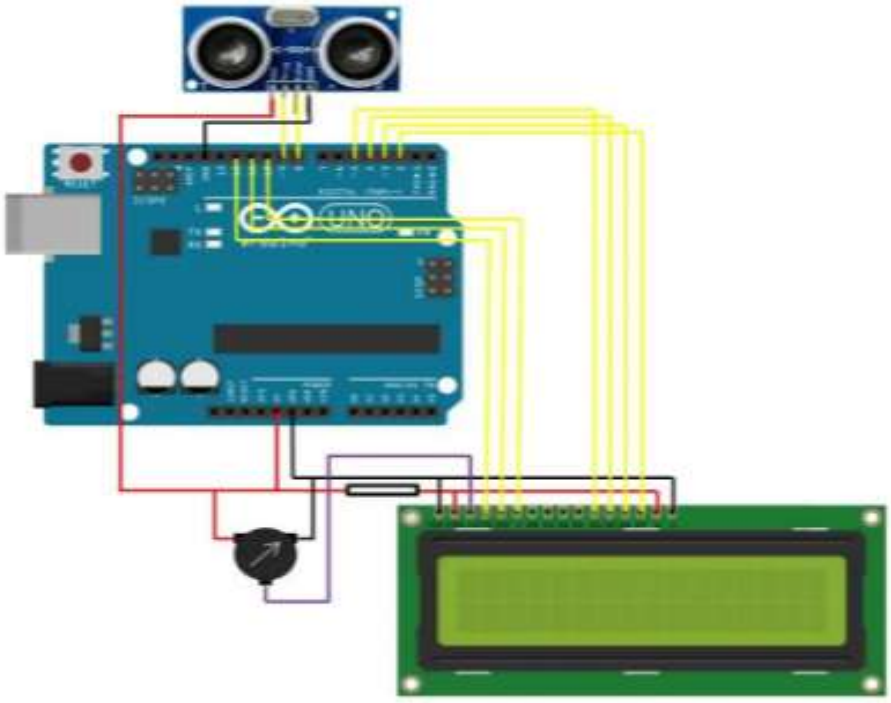

Fig 06. Circuit Diagram

WORKING OF ULTRASONIC SENSOR:-

- The high-level signal is sent to a 10 microseconds using a Trigger.
- The module sends 40 KHz signals automatically and then it detects whether the pulse is received or not through Echo.
- If the signal is received, then it is through a high level. The time of high duration is the time gap between sending and receiving the signal is been calculated

Ultrasonic sensor distance measurement formula
Distance = (Time x Sound speed in the Air (340 m/s))/2

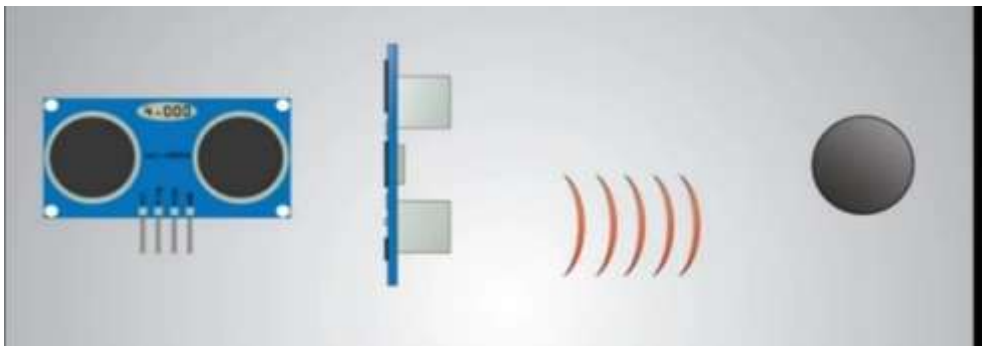

Fig 07.Emits Ultrasound

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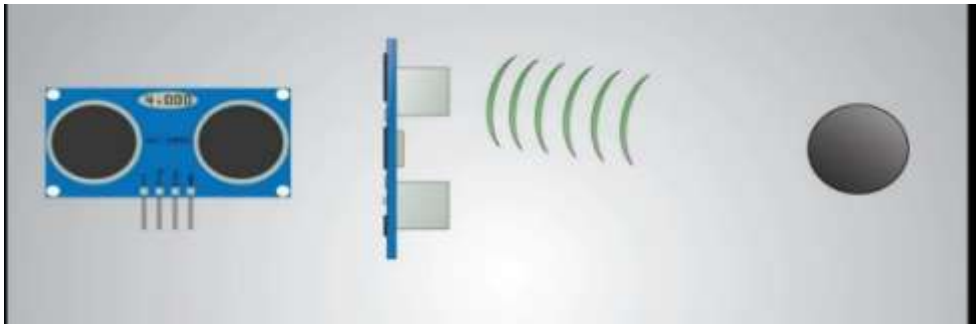

Fig 07.Ultrasound bounce back

2.3.1PROGRAM :

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16,2);
const int trigPin = 3;
const int echoPin = 2;
long duration;
int distanceCm, distanceInch;
void setup() {
lcd.init();
lcd.begin(16, 2); // Initializes the interface to the
LCD display
lcd.backlight();
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
Serial.begin(9600);
}
void loop() {
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
distanceCm = duration * 0.0340 / 2;
distanceInch = duration * 0.01330 / 2;
lcd.setCursor(0, 0);
lcd.print("Distance: ");
Serial.println(distanceCm);
lcd.print(distanceCm);
lcd.print(" cm");
lcd.setCursor(0, 1);
lcd.print("    ");
lcd.print(distanceInch);
lcd.print(" inch");
delay(1000);
```

2.3.2 FEATURES OF USING ULTRASONIC SENSOR :

1-By using ultrasonic sensors wewilldetermine the depth of the hole.

2-

Thenfeedthedepthintheardinoboardsothatthemechanism stopsoncethedesireddepth is reached.

IV. COMPONENTTSREQUIRED FOR PROJECT WORK

1.DISTANCE MEASUREMENT USING ULTRASONIC SENSOR AND ARDUINO

In this project, we have used HCSR-04 to determine the distance of an obstacle from the sensor. The basic principle of the ultrasonic distance measurement is based on ECHO. When sound waves are transmitted in the environment then waves are returned back to the origin as ECHO after striking on an obstacle. So we only need to calculate the traveling time of both sounds means outgoing time and returning time to origin after striking on an obstacle

Fig 08. Ultrasonic Sensor

1.1 ARDUINO

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Arduino is an open-source electronics platform based on easy to- use hardware andsoftware. These boards are able to read inputs and turn output motor, LED ON off. In this set of instructions are provided to microcontroller on board that uses for arduino programming language (based on wiring) and arduino software (IDE) based on processing. The arduino uno microcontroller operates at 5v with 2Kb of RAM, 32Kb of flash memory for storing programs and 1Kb of EEPROM for storing parameters. It operates at a clock speed of 16 MHz, that translates 3,00,000 lines of C source code per second. The board has 14 digital Input output pins and 6 analog input pins. The device holds a variety of configurations features of usual peripherals: internal oscillator, timer including PWM, Watchdog, USART(universal synchronous asynchronous receiver transmitter) and SPI(serial peripheral interface)

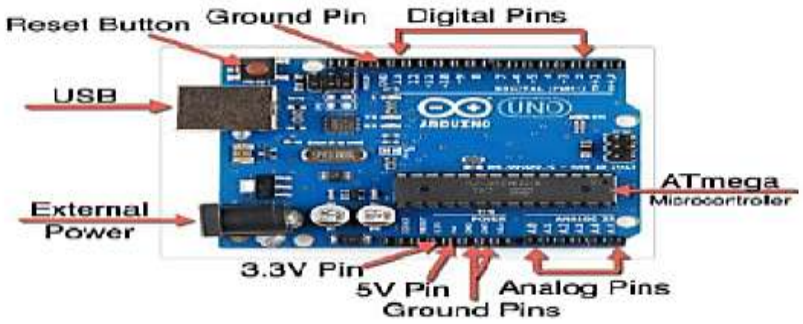

Fig 09. Arduino Board

1. Micro-controller : ATmega328.
2. Operating Voltage : 5V.
3. Input Voltage (recommended) : 7-12V.
4. Digital I/O Pins : 14 (of which 6 provide PWM output).
5. Analog Input Pins : 6

1.2 FEATURES :

The Arduino Uno R3 with Cable is AN microcontroller board that relies on the ATmega328. it's fourteen digital input/output pins (of that six may be used as PWM outputs); six area unit analog inputs, a sixteen megacycle per second ceramic resonator, a USB association, an influence jack, AN ICSP header, and apush button. It contains everything required to support the microcontroller; merely connect to a laptop with a USB cable or power it with AN AC-to-DC adapter or battery to urge started.

2. The 5V 2 CHANNEL RELAY MODULE

Fig 10. 5V 2 CHANNEL RELAY MODULE

1. The module using Single relay control.
2. AC voltage 250V, AC current 10A, maximum DC voltage 30V DC current maximum 10A.
3. Power indicator (green), Two ways of relay status indicator light (red).
4. Using 8550 transistor-driven, strong driving ability.
5. Has the fixed bolt hole and easy installation

2.1 Features :

This is a a pair of Channel 5V Relay module, be ready to management numerous appliances, and

different instrumentality with massive current. It may be controlled directly by Microcontroller (8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic).5V 2-Channel Relay interface board and every one desires 15-20mA Driver Current Equipped with high-current relay, AC250V 10A; DC30V 10A commonplace interface which will be controlled directly by microcontroller (8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic) Indication LED's for Relay output standing.

V. CONCLUSION

• From this project wewillbe able to tighten thescrew up to a specificdepth.

• Henceitwouldminimizethefailures occurringdueto loosescrews ornuts.

•Alsowearegoingtouseelectricalscrewtighteningmachinesoitwouldbecheap, canbe handled easily andalso can becarried from oneplace to another

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