

ROBOTIC VEHICLE METAL DETECTOR

Project report submitted in partial fulfillment of the requirement for the degree of

BACHELOR OF TECHNOLOGY

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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UNDER THE GUIDANCE OF

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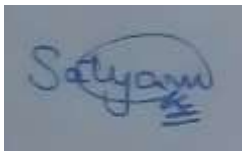
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DECLARATION

We hereby declare that the work reported in the B.Tech Project Report entitled “**Robotic vehicle metal detector**” submitted at **Jaypee University of Information Technology, Wagnaghat, India** is an authentic record of our work carried out under the supervision of **Dr. Shweta Pandit**. We have not submitted this work elsewhere for any other degree or diploma.



Satyam Kumar

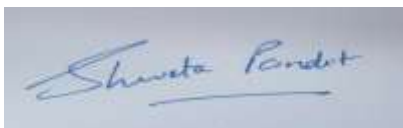
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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.



Dr Shweta Pandit

Date:

Head of the Department/Project Coordinator

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All of the members have put efforts in this project which was made possible with the help and guidance provided by the many individuals to whom we would like to extend our sincere thanks.

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LIST OF ACRONYMS AND ABBREVIATIONS

1. Unexploded Ordnance (UXOs)
2. Improvised Explosive Devices (IEDs)
3. Personal Protective Equipment (PPE)
4. AM (amplitude modulated)
5. Collector-Emitter (V_{CE})
6. Base-Emitter (V_{BE})
7. GND - Ground
8. SRAM (Static Random Access Memory)
9. IDE (Integrated Development Environment)
10. FTDI (Future Technology Devices International)
11. PWM (Pulse Wave Modulation)
12. EDR (Enhanced Data rate)
13. AFH (Adaptive Frequency Hopping)
14. SPP (Serial Port Protocol)
15. USART (Universal Synchronous/Asynchronous Receiver/Transmitter)
16. RPM (Revolutions Per Minute)

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ABSTRACT

The detection of metal is explained in this project with the help of sensing based on inductors. Metal detectors are devices employed to capture the presence of a metal around its vicinity without actually touching it. The fact that the presence of a metal can vary the inductance value of an inductor is what the basic concept of detection is in the project. The model proposed here presents an altered version of an inductance meter, one that is used due to its capability to sense the change in the value of inductance hence triggering an output.

The device which is supposed to measure the unknown intended inductance value of an inductor or a normal coil of wiring is called an inductance meter consisting of a capacitor and an inductor connected to each other in parallel fashion i.e. the project makes use of a 'tank circuit'. Whenever the presence of a metal is detected in its vicinity, it varies the natural resonating frequency of the tank circuit. The Arduino board has been used to develop a prototype since it is a rather easy-to-use platform for prototyping. The project model is made to sound an alarm with the help of a buzzer placed on a breadboard along with the other components including an inductor.

The prototype is based upon the working of an inductor-capacitor pair tank circuit. LC circuits are generally intended for picking out a signal at a certain value of frequency among a combination of signals or in order to generate signals at a certain frequency. This process is known as a band pass filter. These are important components in a large number of devices used in electronic equipments like radio and in circuits such as oscillators, frequency mixers, filters, tuners etc.

An ideal LC circuit generally assumes there is no loss in the form of energy dissipation due to potential offered resistance, in other words, it is an idealized model. In practicality, the actualization of such LC circuit sought to always show the presence of loss as a result of tiny but non-ignorable resistance present within the connecting wires or components. The basic purpose of such an LC circuit is to generally to oscillate with as little as possible swaying or damping from the ideal scenario, so the resistance is kept as low as possible. Although there is no practical circuit possible without the presence of losses but it is however very instructive to go into the study of this ideal form of this mentioned circuit in order to have an understanding along with a physical visualization.

CHAPTER 1

INTRODUCTION

1.1 The general metal detector

The basic working principle of metal detector is very simple and is based upon principles of electromagnetic induction. As indicated by the name, it is an electronic device that identifies whether metal parts are present in or around places that are generally hard to reach, like inside rocks, in closed bags, under the earth etc. Such metal detectors are employed in detecting objects from something as dangerous as land mines to things as valuable as gold mines.

A metal locator can undoubtedly have the option to identify the nearness coins, costly gems, pieces of gold, heaps or whatever we are searching for without the information on how our very indicator capacities. So as to show signs of improvement grasp of what the indicator is really doing, it is basic to see how a general metal locator functions. Initially, suppose we are checking in the field and get a finder signal. We burrow down a foot and discover nothing. We develop the opening and burrow another foot and still don't discover anything. We may continue burrowing to five or six feet before at last surrendering. However, our sign endured all through such a lot of burrowing! What turned out badly? Was it our deficiency, or that of our identifier? Was an objective there? A chance is that the reaction could have been because of some variety or nearness of some measure of mineral substance. For the subsequent model, suppose we are examining for a little pot made of iron that is loaded up with some valuable metal. Wouldn't a metal identifier happen to extraordinary assistance here?

The Arduino based metal detector explained in our task is fundamentally a frequency meter which gauges the resonating frequency or timespan of a tank circuit. The resonating frequency of the tank circuit, albeit fixed, can be differed somewhat because of the nearness of metals in its region. The connection of an inductor and a capacitor connected in parallel represents a tank circuit in general. This circuit is also called parallel LC circuit, in which the 'C' denotes the capacitor and 'L' denotes the inductance. By suddenly discharging this tank circuit after a short time of constant charging we are able to oscillate it at its resonating frequency. The tank circuit will generate 'Damped oscillation' which is a type of oscillation that occurs once discharging starts. ^[1]

1.2 The LC Tank Circuit



Figure 1: An LC tank circuit

Consider this charged Capacitor is associated over the inductor through a switch S as appeared in figure 2. At the point when the switch S is shut, the regular current stream moves from plate A to B through the inductor loop, diminishing the energy put away or quality of the electric field in the capacitor.

An EMF is induced which contradicts the electrons stream because of the current moving through the inductor. This current stream develops a magnetic field around the inductor for example it begins putting away magnetic energy. Current or electron course through the curl becomes zero when the capacitor is completely released. As of now there is no electric field and magnetic field has greatest worth.

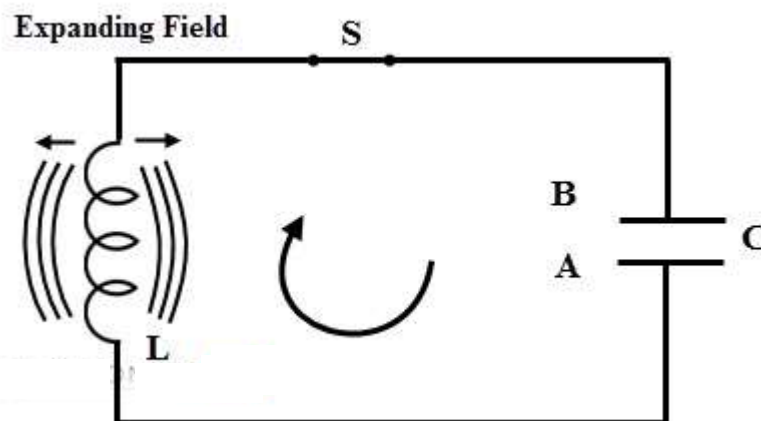


Fig. 2: Expanding Field

As soon as the magnetic field present near the inductor starts going down it creates an opposing, counter emf. According to Lenz's law this counter emf generates the electric current which starts to electrically charge the capacitor but with a reversed polarity by making the upper plate negatively charged where as the lower plate positively charged.

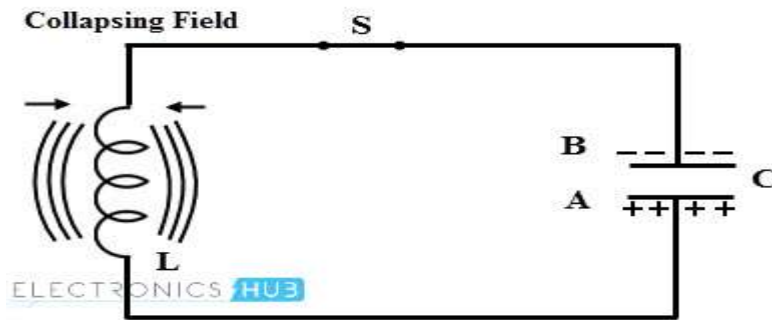


Figure 3: Collapsing Field

The whole magnetic energy is transformed back into the electric energy in capacitor once the capacitor is fully charged in opposite direction that is, the magnetic energy is non-existent. It is at this moment the capacitor begins losing charge in the opposite direction and after some more time the capacitor gets completely devoid of charge and the entire process is continued once again.

This nonstop charging and releasing procedure results in a substituting movement of electrons which is only a swaying current. Yet, these motions of the capacitor are damped in light of the fact that each time moving of vitality from L to C and C to L disperses vitality as warmth in the opposition of the loop and in the associating wires as electromagnetic radiation. These misfortunes decline the sufficiency of swaying current progressively till it stops. These type of motions are called as damped motions or exponentially decaying motions.

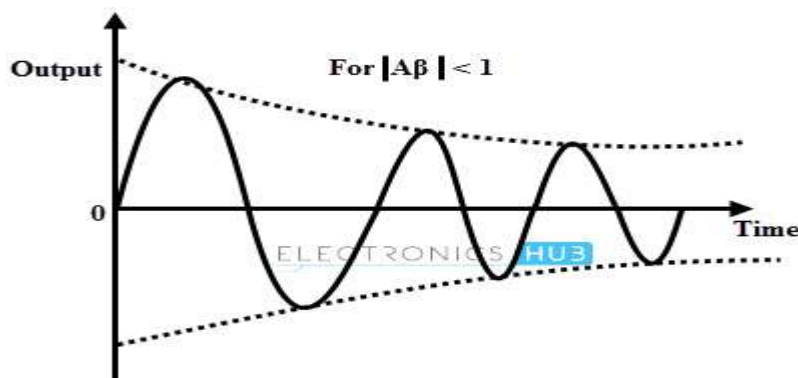


Figure 4: Decaying Oscillations

CHAPTER 2

Literature Survey

2.1 DEMINING

Land mines happen to be basic in various classifications of different dangerous gadgets, for example, unexploded ordnance (UXOs), improvised touchy devices (IEDs) and booby traps. The meaning of landmine may incorporate "extemporized" albeit most mines are manufacturing plant built. Dangers emanating from IEDs are significantly grave, but processing plant fabricated landmines are regularly more plentiful and longer enduring. During 1999 to 2016, yearly setbacks from unexploded weapons and landmines have changed somewhere in the range of 9,228 and 3,450. In 2016, 20% of the setbacks were taken by the military and security faculty, 78% of the losses were endured by regular people among which 42% were kids, and a low 2% by deminers.^[2]

Against tank and anti-staff are the two principle classes of land mines, hostile to tank ones are intended to harm tanks or comparative overwhelming vehicles and subsequently they are typically bigger and require at any rate 220 pounds of power to trigger so personnel or infantry or other light weight resources don't trigger them.



Figure 5: Soldiers searching for land mines

People killing mines are intended to mutilate or slaughter fighters. These mines come in two fundamental groups: fragmentation and impact. Impact mines are covered near the surface and activated by pressure. A load somewhere in the range of 1.8 kg to 10.9 kg, the heaviness of a little kid, is normally enough. Generally they are barrel shaped with a width of 2–4 inches (5.1–10.2 cm) and a tallness of 1.3 to 3 inches. Some mines are made with the purpose to detonate outwards, at times "bouncing" upward and detonating over the ground, bringing about losses as much as 100 meters away. Tripwire identification is fundamental since they are ordinarily enacted by tripwires that can be up to 20 meters from the mine.

Land mines are found in around 60 nations. Deminers need to manage unpleasant situations that may incorporate deserts, wildernesses and other such unforgiving landscapes. Against tank mines are covered somewhere inside where as people killing mines are most ordinarily found inside 6 creeps from the surface, dissipated from planes or put by hand, in normal or unpredictable examples. Indicators can be confounded by high-metal soils and garbage which is the reason demining presents a not all that straightforward designing test.

Demining faculty are issued personal defensive equipment (PPE) which incorporate visors, head protectors, vests, heavily clad gloves and specific shoes, so as to secure them if there is a peril of a mine setting off unintentionally. As indicated by the IMAS principles a few pieces of the body be shielded against an impact from 240 grams of TNT when set at separation of 0.6 meters. The advantages of impact safe boots are problematic and the boots may ingrain a misguided sensation that all is well and good.

Despite the fact that the hardware suggested by the IMAS can bear the cost of critical insurance against people killing impact mines, the IMAS gauges recognize that they are not adequate to give total security against discontinuity and antitank mines. Heavier protective layer is solid however increasingly awkward, and there is an improved probability that faculty managing mines won't wear the gear. Different methods of overseeing hazard incorporate better identifiers alongside remote-controlled vehicles so as to expel fracture mines, since quite a while ago took care of rakes for working from a protected separation. uncovering and unmanned ethereal vehicles to scout the perils before managing these mines straightforwardly.



Fig 6: PROM1- Land Mine

2.2 Archaeological exploration

Metal locators discover significant use in prehistoric studies with the primary known use by the military student of history by the name of Don Rickey in 1958. He distinguished the terminating lines at Little Big Horn. Anyway archeologists don't empower the utilization of a metal locators by searchers of "ancient rarity" or "site thieves" whose exercises can conceivably hamper archeological sites. The setting that the item was found in is lost and no nitty gritty overview of its environmental factors is made in archeological locales if a specialist discovers objects of conceivable archeological intrigue. Outside of known destinations the hugeness of items may not be a lot of obvious to a metal finder hobbyist.[3]

There are various side interest exercises which include the utilization of metal indicators:

Mint piece shooting is one model where some currency shooters lead recorded research or examination so as to find destinations which can conceivably surrender collectible and chronicled currencies.

Prospecting is the way toward searching for significant precious metals including copper, silver and gold in their characteristic types of pieces, minerals or chips.

Something fundamentally the same as coin shooting is general metal distinguishing with the exception of that the client is after a relic. Some detectorists might be devoted to saving recorded ancient rarities, and frequently have impressive mastery in this specific territory. Relic trackers normally discover shots, catches, hatchet heads, coins, and clasps among not many of the things; when all is said in done the potential is far more prominent in places like Europe and Asia than in numerous different pieces of the world. A portion of the more significant finds in Britain alone comprise of spots like the Staffordshire Hoard of Anglo-Saxon gold, Roman Crosby Garrett Helmet, Stirling Hoard, Milton Keynes Hoard, , Collette Hoard and a large number of comparable lesser finds.

Sea shore combing is another movement including chasing for lost coins or gems on sandy sea shores. Sea shore chasing can be as basic or as confused as one wishes to make it in light of the fact that many committed sea shore trackers additionally acquaint themselves with its complexities like sea shore disintegration and tide developments.

2.3 Security Screening



Figure 7: Metal detectors at airport

Multiple aircraft hijackings inside a short period made the United States in 1972 receive metal finder innovation so as to screen aircraft travelers. To start with magnetometers that were initially intended for logging tasks were utilized for the recognition of spikes in trees. Outokumpu, a Finnish company introduced mining metal indicators during the 1970s which were still put away in a round and hollow funnel, to make a universally useful stroll through security detector. The advancement of such comparative frameworks proceeded in an alternate organization and gadgets given the name of Meteor Metal Detectors transformed as such items are now standard in practically all air terminals. The structure of the loops and the gadgets pushed ahead as the advancements in different employments of metal indicators both in beat gadgets and substituting current were utilized, to expand the separation capacity of these frameworks. Little universally useful manually operated metal identifiers are additionally employed to find metals on an individual all the more unequivocally and are utilized all the more broadly nowadays. Frameworks, for example, the Meteor 200 showed up in 1995 which paraded the capacity to quantify the assessed tallness of the metal item over the ground reference, permitting security work force to all the more quickly and precisely find the wellspring of the clear yield signal.^[4]

2.4 Industrial metal detectors

Mechanical metal finders are utilized in countless exercises including however not constrained to pharmaceutical, article of clothing and material, food, drink, plastics, bundling, wood and mining businesses.

Pollution of food because of the nearness of metal shards rising up out of broken or incomplete handling apparatus during the assembling is a significant wellbeing issue present in the food business. For this reason metal indicators are generally utilized and coordinated into the separate creation lines.

Applying metal distinguishing after the articles of clothing are totally sewn and before pieces of clothing are pressed is the current most utilized practice at article of clothing or attire industry plants which help to check if any metal pollution is present (broken needles, metal scraps and so on) present in the articles of clothing.

The modern metal locator was first evolved by David Hiscock and Bruce Kerr in 1947. Gutting Kerr, the establishing company pioneered the utilization and improvement of the main known mechanical metal detector. A company called Mars Incorporated was among the principal clients of people like Goring Kerr utilizing their “Metlokate” metal identifier to inspect metal bars.^[5]

Central standard of structure for the essential present day metal marker relies upon a 3 curl arrangement. This structure takes help of an AM transmitting circle along with two tolerating twists placed on both the sides of the transmitter. The arrangement and physical plan of the tolerant curls are instrumental in the ability to recognize minimal metal pollutes of 1 mm or lesser. Present day metal discoverers continue utilizing this course of action for the acknowledgment of tramp metal.

Configuration of the circular part is with the ultimate objective that it makes an opening whereby objects under consideration experience the loops. The opening makes the object move in and out of the triple coil system conveying a proportionate anyway thought about sign the two getting circles. The resulting signs are included reasonably refuting each other. Fortress Technology built up another component allowing the twist structure of their BSH Model to neglect any possible effects of vibration, even while analyzing conductive things.

Exactly as a possible metal contaminant is brought into the thing a conflicting irritation is made. This by then makes an incredibly minimal electronic sign. Post the heightening of a mechanical

device mounted to the transport framework is motioned to remove the soiled thing from the creation line. System is completely motorized and allows gathering to work in a nonstop manner.

2.5 Present land mine prone areas

Land mines are disputable in light of the fact that they stay hazardous after the contention in which they were conveyed, affecting or harming regular citizens and rendering land closed and unusable for quite a long time. Referred to casually as the Ottawa Treaty, the 1997 Convention of the International Campaign to boycott landmines came a full circle on the prohibition of their use, stockpiling, production as well as transfer of anti-personnel mines and on their destruction that had been seeking to forbid their utilization. The UN assesses that it will take about 1,100 years to get rid of all the mines in the world with current innovation.^[6]

Somalia

Total number of landmines - 1 million

Various inner and territorial clashes over just about a forty-year time frame have resulted in the mine concern in Somalia, with the first mine-laying report in 1964. Focal and southern parts of Somalia are vigorously debased with unexploded weapons (UXO) and mines. According to the UN, the financial effect of landmine-laying is evident in pretty much all parts of their society: decreased plot accessible to animals as well as for agrarian creation, expanded conveyance expenses, horrible showing in restoration and advancement endeavors, death toll, inabilities, an overall absence of sanctuary amongst the people, and obstructions to rehabilitation. Losses keep on being accounted for from mines and UXO. The UN holds the opinion, in any case, that the threat of UXO and mine in the country of Somalia is "a limited issue" and one that "given continued consideration," can be resolved in a 7-10 year time frame by means of satisfactory assets. However, since the 1991 collapse of the government of Siyad Barre resulted in it being left without a focal government and thus, Somalia can't consent to the Mine Ban Treaty.

Mozambique

Total number of landmines - 3 million

After about three decades of war, Mozambique is probably the least fortunate nation in Africa. Grain is imported and the economy relies vigorously upon assistance from other countries. Mozambique is confronted with desertification, contamination of surface and seaside waters, and serious dry spell and floods in the focal and southern territories. Moreover, quite a bit of its farmable land is unworkable in light of landmines. Mines fabricated in 15 unique nations were utilized by every party in the battling, quickening a staggering starvation cycle during the 1980s that sent an immense outcast departure over the outskirts with South Africa, Zambia, Tanzania and Malawi. As per Handicap International, an expected 20 individuals step on landmines consistently in Mozambique. 60% of them pass on in light of the fact that they need access to wellbeing administrations. In 1996, Mozambique's Defense Minister assessed that there were still around 3 million landmines in the country. The obliteration brought on due to mines is alarming. Notwithstanding farmable land, electrical cables, streets, extensions, railways, and air terminals, even schools, manufacturing plants and cows plunge tanks were mined. Natural life is additionally disrupted by mines: elephants mutilated by mines meant for people and slaughtered by mines meant for tanks. Life expectancy in Mozambique has been brought down to about 46 years.

Bosnia-Herzegovina

Total number of landmines - 3 million

The country is intensely defiled with landmines and unstable leftovers of war, fundamentally because of the 1992-1995 clash identified with the separation of the Socialist Federal Republic of Yugoslavia. The mine tainting is commonly less dense. Mines were utilized broadly along showdown lines, which moved habitually. Most minefields are in the zone of division between the two elements; this is 1,100 km in length and as much as 4 km wide. Southern and focal Bosnia-Herzegovina witness mines being frequently utilized arbitrarily, with low records of the same. A good portion among the influenced domain is uneven or vigorously forested, yet the ripe horticultural belt in Brcko District seems to be a very intensely defiled region. Consistently landmines execute or harm 30-35 individuals, 80% of them regular citizens. The nearness of these

destructive weapons is preventing recreation, seriously decreasing food creation and redirecting assets expected to modify society. Up until this point, just a little level of mine-defiled land has been cleared by compassionate norms. Most minefields stay plain.

Kuwait

Total number of landmines - 5 million

The country's past is full of disquiet because of the immense measure of oil present all through the nation. In the Gulf War, Iraq involved Kuwait from August 1990 to February 1991. The Iraqi soldiers planted a huge number of AP and AT mines in the "Kuwait Theater of Military Operations." About 97.8 percent of the country's land has been mined or UXO contaminated. the Kuwait-Saudi Arabia fringe as well as Kuwait Bay are some intensely mined regions. Following Kuwait's freedom, the legislature got ready for an incorporated mine activity program. The length was two years and cost \$128 million (U.S.). As per the Landmine Monitor Report, as of April 3, 1999, very nearly 2 million landmines had been recouped from seaside and desert regions of Kuwait. An awareness program was introduced to illuminate regular people of the perils regarding landmines.

Cambodia

Total number of landmines - 8-10 million

Thirty years of war in Cambodia have shaken up numerous structures all through the nation. Lamentably, one of the most enduring inheritances of the contentions keeps on asserting new casualties every day. Land mines, laid by the Khmer Rouge, the Heng Samrin and Hun Sen systems, the Vietnamese, the KPNLF, and the Sihanoukists litter the open country. Most of the time, the people laying the mines kept no account of the region. Presently, Cambodia has the probably the most noteworthy pace of physical handicap of any nation on the planet. While evaluation information for Cambodia is crude, it is commonly acknowledged that in excess of 40,000 Cambodians have endured removals because of mine wounds since 1979. That speaks to a normal of about forty casualties every week for a time of twenty years. Although their use by the military has ceased, the gadgets are now being utilized in novel and ghastly manners: Civil residents are utilizing them to secure property and resolve debates; poachers are allegedly utilizing mines to

kill tigers; and once in an episode in 1998, police encompassed a woodland with mines so as to catch a homicide suspect who had taken shelter there. He rose up out of the backwoods and stepped on a mine, and was then shot to death by police. Seeing the present pace, it might take upwards of 100 years to get rid of every mine in Cambodia.

Iraq

Total number of landmines - 10 million

The country of Iraq is seriously influenced by mines and unexploded arms (UXO) because of the 1991 Gulf War, the 1980-1988 Iraq-Iran War, two many years of inner clash, and even World War Two. Landmines and UXO represent an issue in the north, along the Iran-Iraq fringe, and all through the focal and southern areas of the nation. The quantity of mines planted in Iraq isn't known, yet it is evaluated by the United Nations to be at any rate 10 million. An as of late finished Landmine Impact Survey affirmed that every one of the twenty-five regions in the three regions (governorates) including northern Iraq are mine-influenced, and 3,444 particular regions associated with mine and additionally UXO sully influence more than 148,000 families (more than one of every five) living in 1,096 mine-influenced networks.

Afghanistan

Total number of landmines - 10 million

The country of Afghanistan has experienced significantly war since the year 1978 and all sides to the different furnished clashes have utilized people killing mines, especially Soviet powers and the Afghan government from 1979 to 1992. Landmines have been planted unpredictably over the majority of the nation. Horticultural ranches, brushing regions, water system trenches, local locations, streets and pathways, both in urban and rustic territories, are sullied. Mines are a significant impediment to repatriation, alleviation, recovery and improvement exercises. Landmines kill or mangle an expected ten to twelve individuals every day in Afghanistan. It is accepted that very nearly 50 percent of landmine casualties kick the bucket because of absence of clinical offices.

Angola

Total number of landmines - 10 to 20 million

Assessments of the quantity of Angolan landmines go somewhere in the range of 10 and 20 million, which compares to at any rate 1 to 2 land mines for each individual in the nation. U.N. gauges put the quantity of Angolan amputees coming about because of the quiet executioners at 70,000. For three decades mines were dispersed in Angola's fields, towns, streets, and other unforeseen spots to scare, mutilate and slaughter guiltless casualties. Land mines have an overwhelming impact upon nature by limiting the development of individuals, discouraging cultivating, upsetting economies, and murdering and mangling numerous blameless men, ladies, and kids. In 1993 an UN General Resolution ban on the deal and fare of people killing area mines was passed. Be that as it may, worldwide accord presently can't seem to be accomplished and Angola's concern proceeds with unabated.

Iran

Landmine and unexploded arms (UXO) tainting in west and southwest Iran, especially the territories of Kurdistan, Western Azerbaijan, Khuzestan, and Kermanshah, results from the 1980-1988 Iran-Iraq struggle. Government authorities guarantee that Iraq planted around 16 million landmines in Iran during the 1980s, debasing a territory of more than 42,000 square kilometers. Landmines and UXO are accounted for to have seriously restricted horticultural creation in the five regions along the Iraqi fringe. They additionally bargain misuse of oil fields. Mine and UXO sully has influenced recorded destinations and ruined archeological investigations in southwest Iran.

Egypt

World War II and the Egypt-Israel wars of 1956, 1967, and 1973 have left Egypt a mine-influenced nation. Egypt frequently refers to a figure of 23 million landmines covered in the nation. Egypt's concern comes from the way that its territory mines are old and difficult to find and were intended for use against tanks, though global analysis is commonly centered around people killing mines. As indicated by the service of barrier, mines have hampered human and monetary turn of events and have murdered and harmed a large number of regular citizens. 7,000,000 mines have alerady been removed from the western desert in the previous 15 years and 3,000,000 from the Sinai desert.

CHAPTER 3

THE METAL DETECTOR

3.1.Metal detector circuit:

Figure 8 shows the metal detector circuit employed in our project. It consist of components and following sections give the detailed description of each components employed.

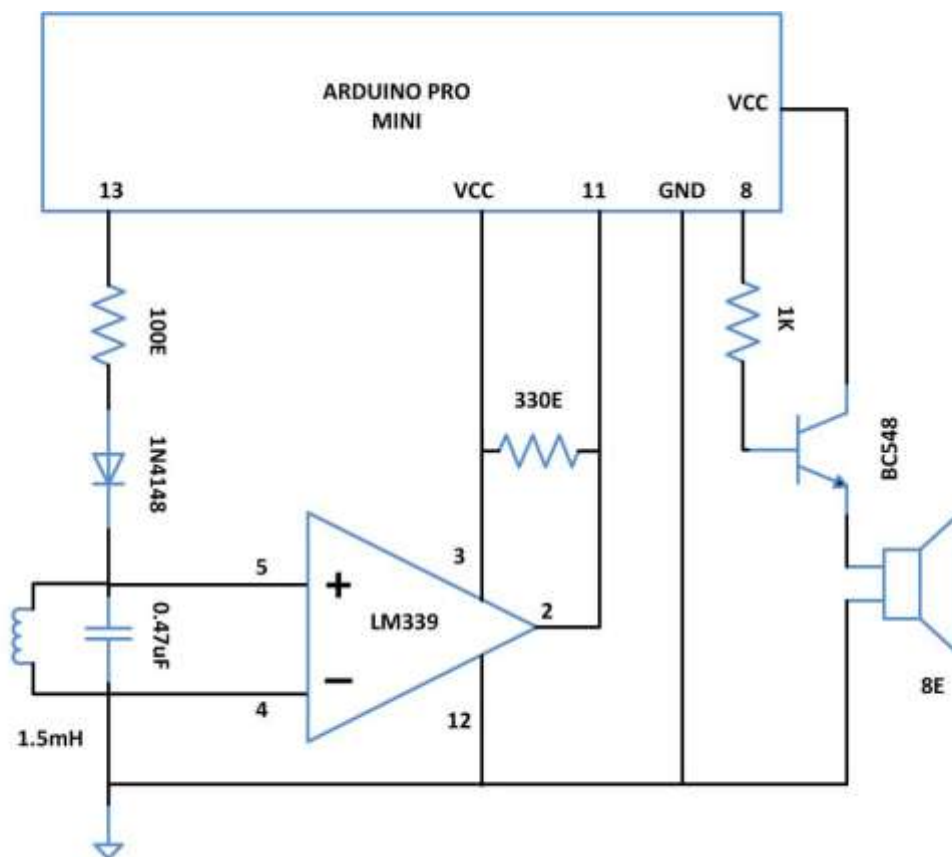


Figure 8: Metal detector circuit

3.2 The Inductor

The inductor in the circuit is based on Faraday's law of electromagnetic induction which explains how metal detection occurs once a current is detected.

3.2.1 Lenz Law

According to Faraday's law this law states that, when an emf induces, the direction or in other words, the polarity of that induced emf is in such a manner that it opposes the original reason of its creation.

As stated by the Lenz's law

$E = -N (d\Phi/dt)$ in volts, where N is the number of turns and Φ is the magnetic flux enclosed

3.2.2 Eddy Currents

The current turns in a certain manner so as to produce a magnetic field which opposes the original change. Due to inclination of the Eddy Currents generated to restrict, they lead to lost Energy. Flow currents change increasingly helpful types of energy like kinetic energy into heat which generally is not commonly valuable. In numerous applications the dissipation of valuable energy isn't especially alluring, yet there are some down to earth applications.

- During the braking process of certain commercial trains in which during slowing down the electric brakes uncover the metal wheels to a magnetic field creating Eddy Currents inside the material of the wheels. The faster the wheels turn, the more grounded is the effect suggesting that as the train moves back the hindering force is decreases, making a smooth stopping development.
- There are barely any Galvanometers having a fixed focus which are of nonmagnetic metallic substance. Exactly when the coil falters, the eddy currents that produce in the middle limit the development and convey the loop to rest. .
- Heaters for the purpose of induction can be brought into use to get ready compounds, by liquefying the metallic objects. The eddy currents which are generated in the metals help achieve temperatures high enough to liquefy it.

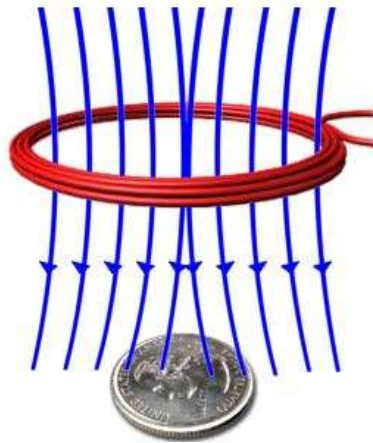


Figure 9: Application of a pulsating current induces a magnetic field (blue)

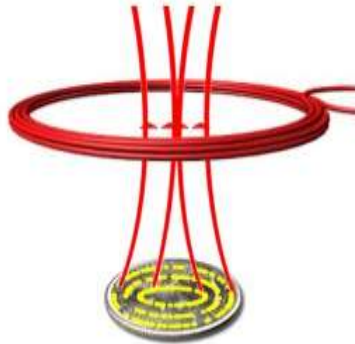


Figure 10: Induced magnetic field

3.3 1N4148 signal diode

The 1N4148 signal diode is a commonly used standard silicon switching and one of the most commonly used signaling diodes. It is one of the most mainstream and enduring switching diodes on account of its trustworthy particulars and minimal effort. Its nomenclature is derived from the JEDEC nomenclature. It is very helpful in switching applications which require a maximum frequency of about 100 MHz possessing a reverse-recovery Time of close to 4 ns.



Figure 11: 1N4148 diode

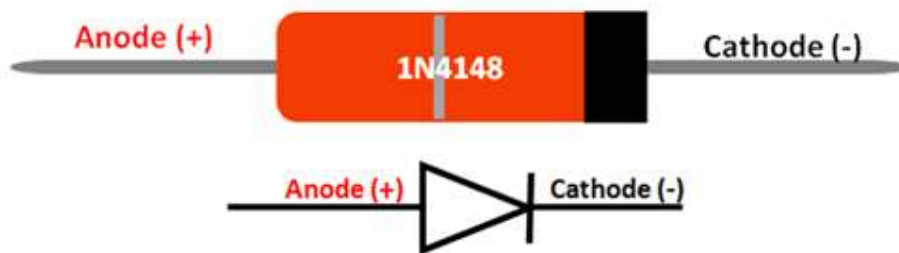


Figure 12: 1N4148 diode pinout

3.3.1 Pin Configuration of the 1N4148

Pin No.	Pin Name	Description
1	Cathode	Electric current always moves out via the Cathode
2	Anode	Electric current always moves in via Anode

3.3.2 1N4148 Diode Characteristics

- Fast switching Diode
- Peak repetitive Reverse voltage is 100V
- RMS reverse voltage is 75V
- Peak forward surge current is 2A
- Forward continuous current I_f 300mA
- Reverse recovery time 8ns
- Available in DO-35 Package

A diode is an electronic device which permits current flow through just a single direction. That is the current ought to consistently move out of the anode to cathode. For 1N4148 diode, the most extreme current conveying limit is 300 milli Amperes it can manage peaks up to 2A. The strength of this diode is its quick recovery time of 8ns at a forward current of 10mA, henceforth this diode is utilized in places where quick switching are involved.^[7]

3.4 LM339 Quad Differential Comparator

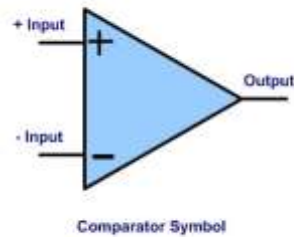


Figure 13: LM339 quad IC

The quad differential comparator LM339 is a voltage comparator IC from LMx39x arrangement produced by numerous enterprises. These gadgets comprise of up to four free voltage comparators intended to work from a solitary power gracefully. Additionally activity using double Supplies is conceivable, as long as the distinction among the two input supplies is from 2-36 V.

3.4.1 Pin Configuration of the LM339

Functioning of each pin is described and the pinout is named in figure 14.^[8]

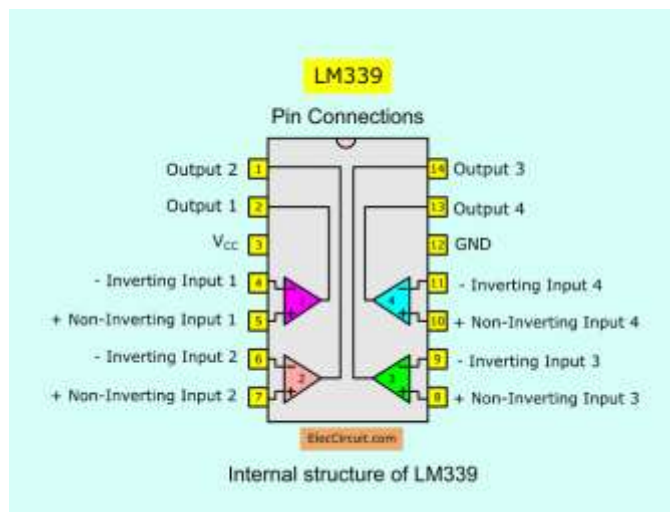


Figure 14: LM339 pin diagram with internal structure

Pin	Name	Description
1	1OUT	Output pin of the comparator 1
2	2OUT	Output pin of the comparator 2
3	VCC	Power supply
4	2IN-	Negative input pin of the comparator 2
5	2IN+	Positive input pin of the comparator 2
6	1IN-	Negative input pin of the comparator 1
7	1IN+	Positive input pin of the comparator 1
8	3IN-	Negative input pin of the comparator 3
9	3IN+	Positive input pin of the comparator 3
10	4IN-	Negative input pin of the comparator 4
11	4IN+	Positive input pin of the comparator 4
12	GND	Ground
13	4OUT	Output pin of the comparator 4

3.4.2 Features and Electrical Characteristics of LM339

- Four individually operated voltage comparators
- Low noise interference among comparators
- Single Supply Operation: +3.0 V to +36 V
- Dual Supply Operation: +18V and -18V
- Low Input Bias Current: 25 nA
- Low Input Offset Current: ± 5.0 nA
- Low Input Offset Voltage
- Input Common Mode Voltage Range to GND
- Low Output Saturation Voltage: 130 mV @ 4.0 mA
- TTL and CMOS compatible
- ESD Clamps on the inputs increase reliability without affecting device operation

LM339 is used in applications or systems which require a comparison between two voltage signals. Furthermore with four of those comparators ready, the gadget can look at four sets of voltage flags one after another which proves to be useful in certain applications. The comparator is mainstream among producers and specialists for being ease and acceptable execution. The gadget reaction is additionally quick enough to fulfill numerous applications.

3.5 BC548 NPN BJT

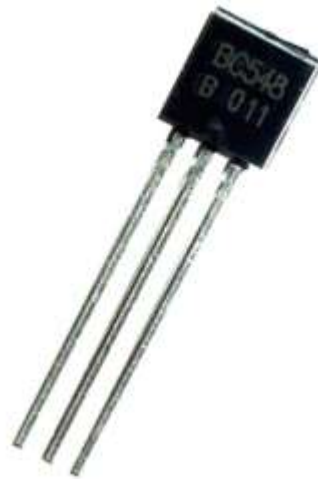


Figure 15: BC548 - NPN Transistor

3.5.1 Pin Configuration of the BC548

Pin Number	Pin Name	Description
1	Collector	Current flows in through collector
2	Base	Controls the biasing of transistor
3	Emitter	Current Drains out through emitter

3.5.2 BC548 Transistor Features

- Bi-Polar NPN Transistor
- DC Current Gain (h_{FE}) is 800 maximum
- Continuous Collector current (I_C) is 500mA
- Emitter Base Voltage (V_{BE}) is 5V
- Base Current (I_B) is 5mA maximum
- Available in To-92 Package

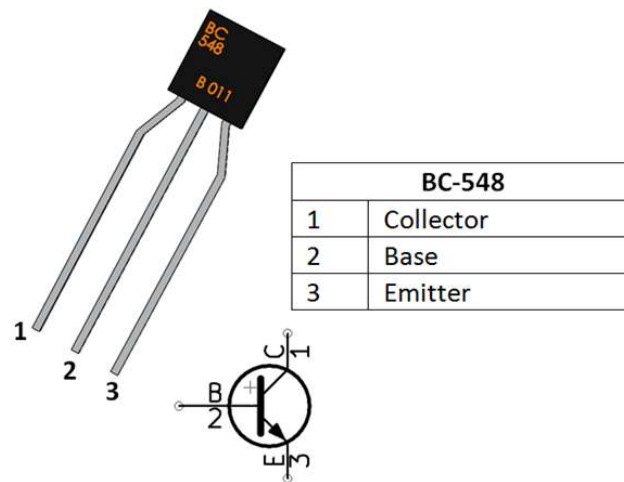


Figure 16: BC548 - NPN Transistor Pinout

The collector and emitter junctions are supposed to be left in Open state owing to the fact that this device is an NPN Transistor. Where as the Base pin is kept in the ground state and must shut or biased forward when a sign is given to Base junction. The device makes a Gain of an estimation of 110 to 800 this value chooses the intensification furthest reaches of the transistor. The best proportion of current that could travel through the gatherer pin is 500mA, from now on we can't interface stacks that exhaust more than 500mA whenever this transistor is being used. ^[9]

Right when BC548 is made to be totally one-sided, it can allow a restriction of 500mA to stream over the collector and emitter. The stage so created is named the Saturation Region and the average Voltage permitted over the Base-Emitter (VBE) or Collector-Emitter (VCE) could be 200 and 900 mV independently. Exactly as soon as the Base Current I_b is removed this stage gets dropped as the cutoff value and also the base producer voltage tends usually to be around the 660 mV mark.

3.6 Arduino: The Pro Mini

This is a microcontroller board created by Arduino.cc and depends on Atmega328. It completes practically same capacities as other Arduino loads up; notwithstanding, it is diverse from Arduino Uno in terms of PCB format, size, voltage guideline, and clock speed.

The Arduino Uno accompanies two voltage controller for example 5V and 3.3V where as the Arduino Pro Mini is accessible with just a solitary voltage controller. There are an aggregate of two sorts of Arduino Pro Mini are accessible for example 5V and 3.3V running at frequencies of 32MHz or 16 MHz individually. In any case, the two variants are accessible independently, with just a single voltage controller when contrasted with Arduino Uno that accompanies adual voltage controller 5V and 3.3V running at frequencies of 16 MHz.^[10]

Most Arduino boards assume an essential job towards the advancement of inserted frameworks and similar different electronic tasks created for an expectation of giving simple equipment with a programming mix in order to give a fast method to individuals with little to no specialized foundation allowing them to get a hands-on involvement in the sheets. These sheets accompany nearly everything that could possibly be needed to build up the tasks that may or may not have any acquaintance with robotization.

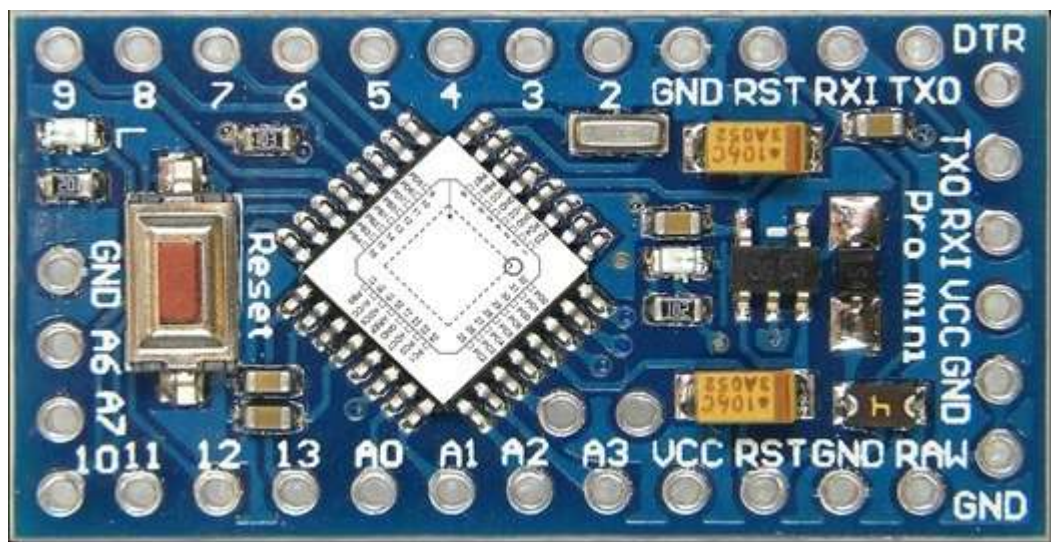


Figure 17: Arduino Pro Mini

- The pro mini board accompanies a total of 14 pins which are computerized I/O of which 6 of them are utilized for giving PWM yield. An aggregate of 8 simple pins are present on the arduino board..
- Much smaller scale compared to Arduino Uno, in fact it is 1/6 of the total size of the Arduino Uno.

3.6.1 Pro Mini Specifications

- There is just a single voltage controller coordinated on the board which is either the 5V or 3.3V type dependent on the version or the type of board in use.
- The Pro Mini generally runs at a known frequency of 8 Mega Hertz in the 3.3V adaptation which is exactly half of that of Arduino Uno board that by default runs at 16 Mega Hertz.
- There is an absence of any USB ports on the surface of the board so as to spare space and it additionally doesn't have a worked in developer.
- The marking on the controller characterizes the adaptation of the board for example KB33 speaks to 3.3V release and KB50 speaks to 5V version. Be that as it may, the board adaptation can likewise be demonstrated by estimating the voltage among GND and the Vcc pins.^[11]
- This board doesn't accompany worked in connectors that give us the adaptability to patch the connector in any capacity we can, in view of the necessities and space accessible for our undertaking
- Similar to Arduino sheets, the Pro Mini is also an open source, for example we can alter and utilize the board as per our necessities as all the information and bolster identified with this board is promptly accessible.
- The protection of overcurrent capacity is one more element that renders it safe for usage in the activities as well as applications in which the current passing through it possibly can influence the general execution of the task.
- The device also accompanies a flash memory of 32KB of which 0.5 is utilized for something known as the bootloader. This memory is utilized for putting away the code being implemented with the help of the board. It is an in-volatile memory and stores data regardless of whether the association with voltage flexibly is lost.
- It has a Static Random Access Memory or SRAM which is a total of 2KB. The RAM is profoundly unstable in nature and essentially relies upon the consistent wellspring of intensity flexibly.

- The EEPROM accompanies 1 Kilo Bytes of memory. It is a perused memory (ROM) and hence allows deletion and rewriting. With the help of higher than normal electrical signals, this memory can be deleted.

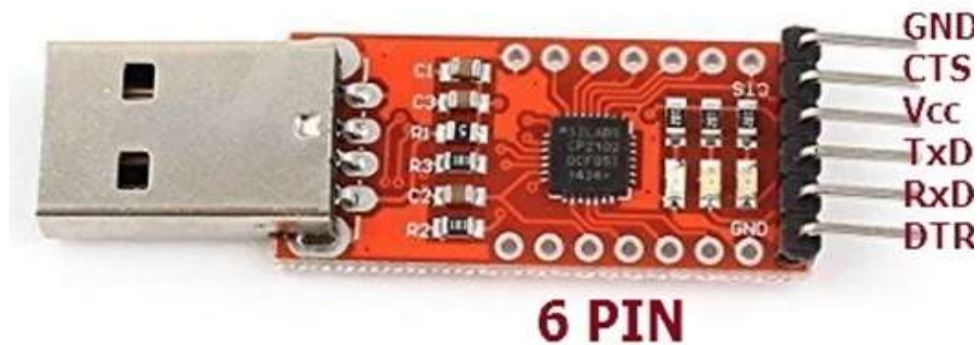


Figure 18: Arduino Pro Mini USB Connector

- The Arduino Software known by the term IDE is utilized to specifically program the pro mini for a particular task. “A sketch” is what is created which acts as the program.
- Analogous to different similar boards accessible within the electronic devices market Arduino Pro Mini additionally accompanies worked in Light emitting diode which will flash as we incorporate and run the significant sketch over the board.

3.6.2 Arduino pro mini compared with different boards

- A large number of Arduino products accompany a USB port that is utilized to transfer the sketch from the PC to the board itself. Anyway if there should arise an occurrence of a missing USB hardware can also set up the code by utilizing USB to sequential converter link. The FT232RL USB sequential module is convenient and among the best for doing so. The hexa-pin FTDI connection with USB to sequential converter will be able to power the USB.
- The Pro Mini adaptation being utilized in this venture accompanies 5V guideline because of the fact that it operated at a frequency of 16 Mega Hertz just like the Uno. Setting up our 3.3V Pro Mini won't be truly good with the Uno, subsequently making it exceptionally hard to program the 3.3V type of Pro Mini.
- Another significant difference is the form factor which sets the device unique.
- Pro Mini by default is exceptionally little in size and making it reasonable for a large number of different sorts of applications. In any case, little size accompanies one

confinement for example it is not very compatible with devices like Arduino Shields except if we manually hard-wire the board with them.

Arduino Pro Mini Set Up:

- Firstly we must download Arduino IDE programming in our PC as it is used as a programming tool to program Arduino products.
- Establish connection with the Arduino board by using an FTDI USB to Serial converter module which is utilized to upload the program from PC to the device.
- The C programming language is used for the sketches.
- There is no need of translating the code and it can straightforwardly edit the code in PC programming and upload it to the Arduino device.
- Once we have written the code and moved it to the board, following stage is to control the board to make it perfect with our venture.
- Other than using the FTDI sequential module we have a couple of different methods to communicate with the board. One is through the RAW which involves fixing the voltage somewhere between 5 to 12 volts. It will consequently lower it to 3.3V or 5V depending on the adaptation of the board. Nonetheless, on the off chance that our venture accompanies a managed voltage of 3.3V, at that point we can associate it directly to Vcc. But we must ensure, the board form is KB33 which by default operates at 3.3V while a different variant KB50 at 5V.
- These two different methods of setting up the device are valuable once we have connected it with the PC and then uploaded the program utilizing FTDI module.

3.6.3 Pinout and schematic of Pro mini

We can divide the schematic of the pro mini into three sections: the voltage controller, ATmega328 along with the peripheral hardware, and lastly the headers.

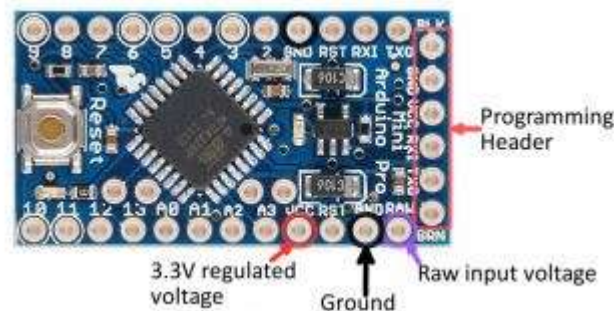


Figure 19: Arduino pro mini pinout

The Pro Mini's Pins encompass three of a total of four different sides which includes pins on the shorter sides being utilized for communication and programming while coordinating with the FTDI Basic Breakout. Where as the the rest of them are a variety of power as well as the GPIO pins.

There are a total of three diverse Power-related Pins present on the board like GND, Vcc, and RAW. GND obviously is the Common/Ground/0V reference while RAW is the input supply that goes into the regulator which can be somewhere in the range of 3.4 to 12V. Voltages available at VCC is provided straightforwardly and adjusted to be at 3.3V.

There are four pins placed on the middle of the board: A4, A5, A6 and A7. Every one of these Analog pins is marked on the rear, while the A4 and A5's area might be significant on the off chance that we plan on utilizing I C with the Pro Mini these are actually the hardware SCL and SDA pins.

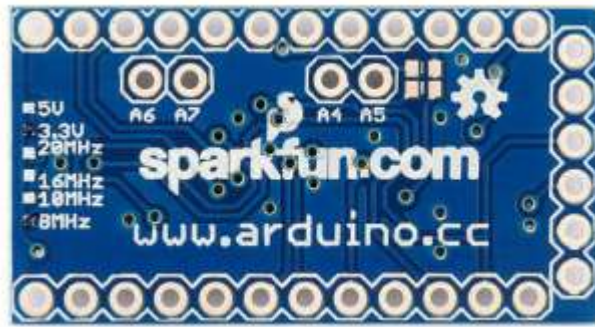


Figure 20: Arduino pro mini rear view

3.6.4 Programming the pro mini

Install drivers for the FTDI Basic Breakout the first time we connect it. The user can have a look at an online manual for setting up the FTDI. Once the drivers have been installed we'll begin by transferring the widely adored code for "Blink".^[12]

Open the sketch for Blink through File > Examples > 01.Basics > Blink.

Before transferring the sketch, we must select what type of board we are using by going to Tools > Board and selecting Arduino Pro or Pro Mini with ATmega328. By doing this we are indicating the code to be in view of a 8 Mega Hertz clock frequency with "delay(1000);". Next we reveal to Arduino which sequential port our FTDI Basic Breakout is assigned. COM2, COM3, and so on are the default ports on Window while on Mac it is "/dev/tty.usbserial-A6006hSc". Now we are good to transfer the sketch to our Mini. Press the Upload button and after a couple of seconds we will see RX/TX LEDs on our FTDI board streak, trailed by a "Done Uploading" message. The Mini might be feeling the loss of a couple of parts, however it has the most significant segment: LEDs..

3.6.5 Applications of pro mini

- There are numerous utilizations of Arduino Boards, yet the little size and usability make Arduino Pro Mini stand apart from others, particularly where space necessity of the venture is profoundly concerned.
- IoT applications
- Mobile applications
- Embedded frameworks
- Home computerization
- Display Systems

CHAPTER 4

THE VEHICLE

Bluetooth vehicle circuit diagram

Fig. 21 shows the circuit diagram of our bluetooth monitored vehicle.

The Bluetooth controlled vehicle will be operated with the help of a mobile phone. The device uses an L298 bridge motor driver to drive four wheel motors. The motor driver is coupled with an Arduino Uno board and an HC05 Bluetooth module board which makes remote operation possible.

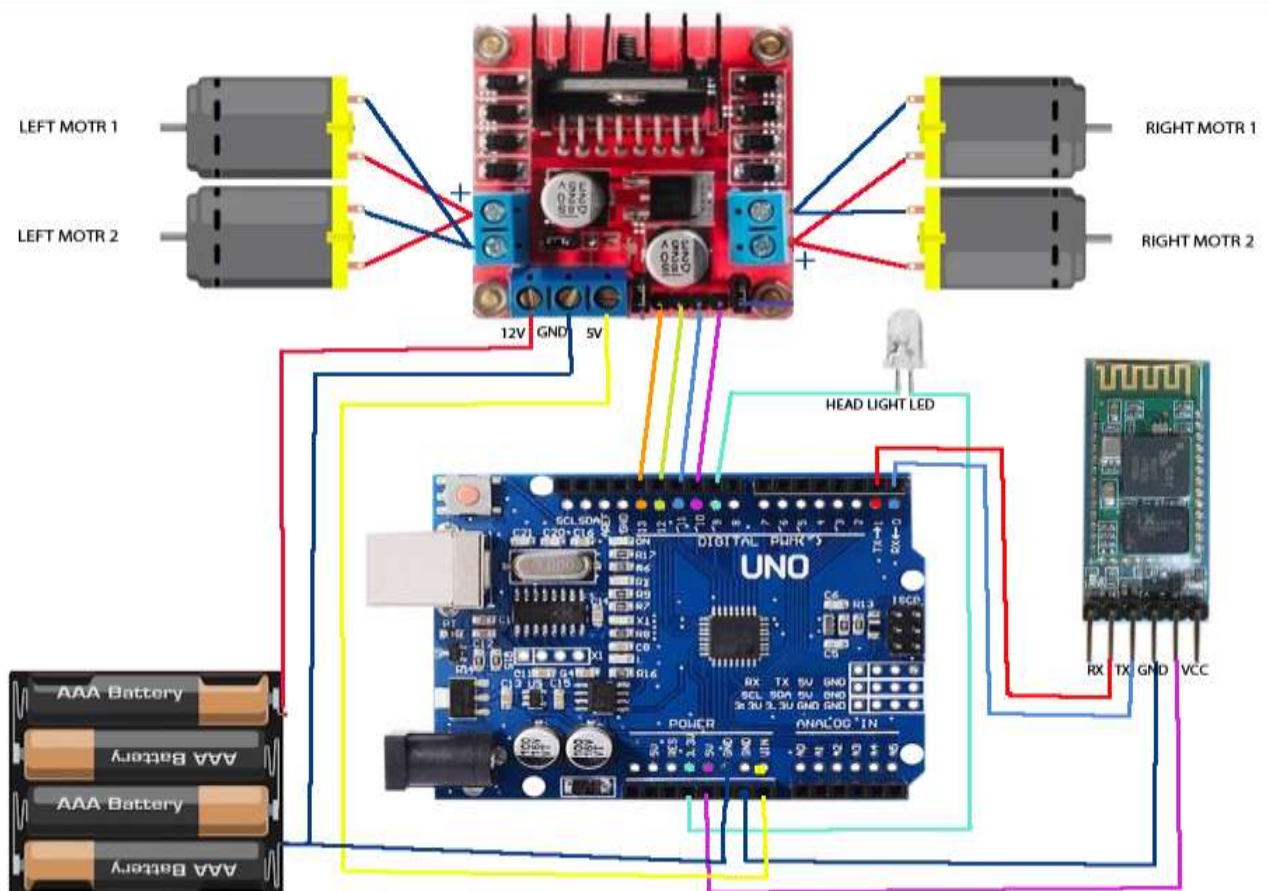


Figure 21: Bluetooth vehicle circuit diagram

4.1 Arduino UNO Rev 3

The Arduino Uno is based on the ATmega328P and comprises of 14 digital I/O pins of which a total of 6 can be implemented as PWM outputs. It has 6 analog inputs along with a 16 Mega Hertz ceramic resonator, a power jack, a USB connection and an ICSP header along with 'reset'. It comprises of all components required for its operation. Simply power it with an AC-to-DC adapter or battery, or connect it to a computer with a USB cable. One can experiment with the UNO without having to worry about doing something wrong as the chip can be replaced for a small amount of money in the worst case scenario and start over again.^[13]

On the Uno, all 14 of the digital pins are capable of being used for output or input with the help of functions like `pinMode()`, `digitalRead()`, `digitalWrite()` operating at 5 volts. Each of these pins are able to tolerate a max current of 40 mA and comprises an internal pull-up resistor, which is not connected by default. Apart from this pins can also have specialized functions:

- **Serial:** 0 (RX) and 1 (TX). Transmits (TX) and receives (RX) TTL serial information. They're connected in correspondence to the ATmega8U2 USB-TTL Serial chip.
- **External Interrupts:** 2 and 3 are free to be configured such that they trigger an interrupt when there is a low value or can be edge-triggered or when there is a change in value.
- **PWM:** 3, 5, 6, 9, 10, and 11. These pins give 8-bit PWM output using the `analogWrite()`.
- **SPI:** 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK) use the SPI library to support SPI communication.
- **LED:** 13. The digital pin 13 has a built-in LED connected to it. The LED is on at HIGH value and off at LOW.

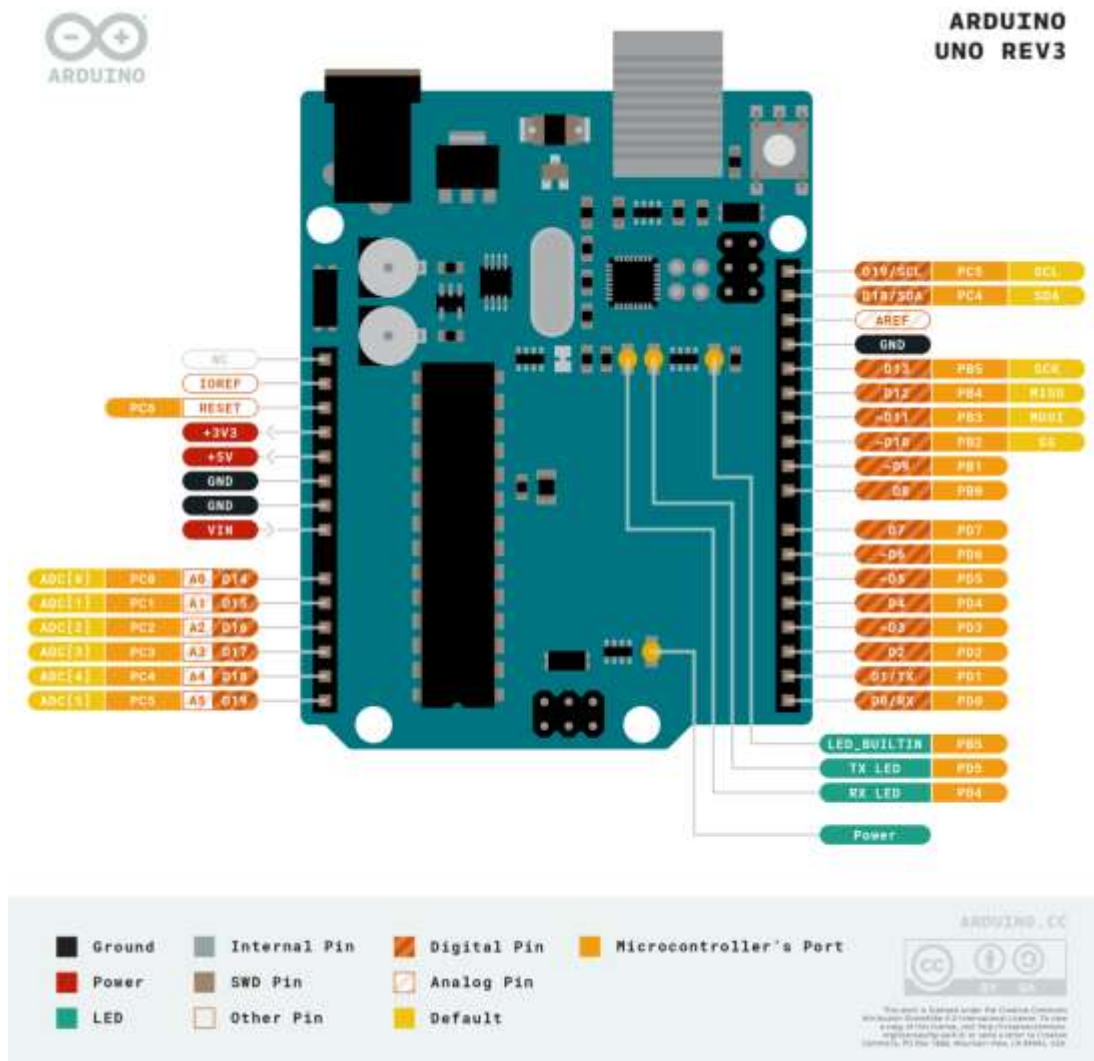
The Uno has 6 analog inputs, labeled from A0 to A5, each of which can provide up to 10 bits of resolution (i.e. 1024 separate combinations). By default they can measure up to 5 volts, although it is equally viable to use the AREF pin to make a change to the upper value using `analogReference()`. Apart from this, some pins are intended to have particular functionalities like

- **TWI:** A4 and A5 pins, also called SDA or SCL pins respectively. Both help manage TWI communication with the help of the "Wire library".

- AREF: Used with analogReference() for reference voltage for analog inputs.
- Reset: Setting it LOW resets the board.

4.1.1 Technical Specifications

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 give Pulse Width Modulated output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P), 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g



4.2 The L298N Motor Driver

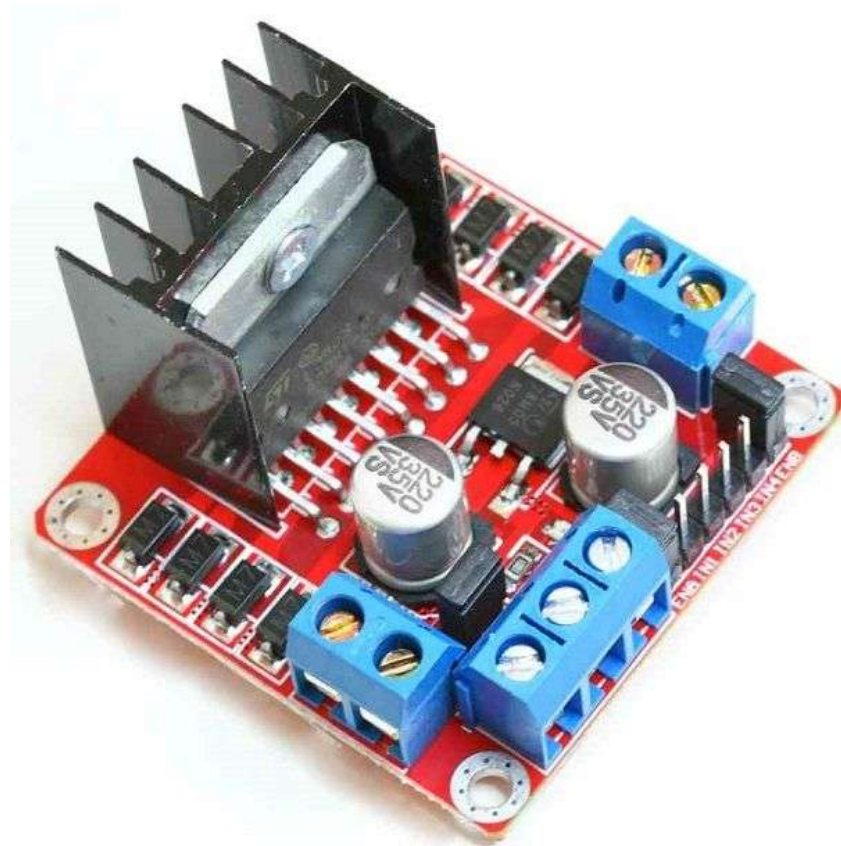


Figure 23: L298N Motor Driver

The L298N is a high output, high voltage double full-bridge driver designed to essentially accept standard TTL logic levels while also being able to run on loads involving inductances, like relays, solenoids and venturing engines. It can be powered or impaired autonomously utilizing two power inputs. The gates of the lower transistors of every half-bridge are situated nearby and an external detecting resistor can be associated with the comparing outside terminal. An extra input is given to make the logic work at a lower value of input voltage.^[14]

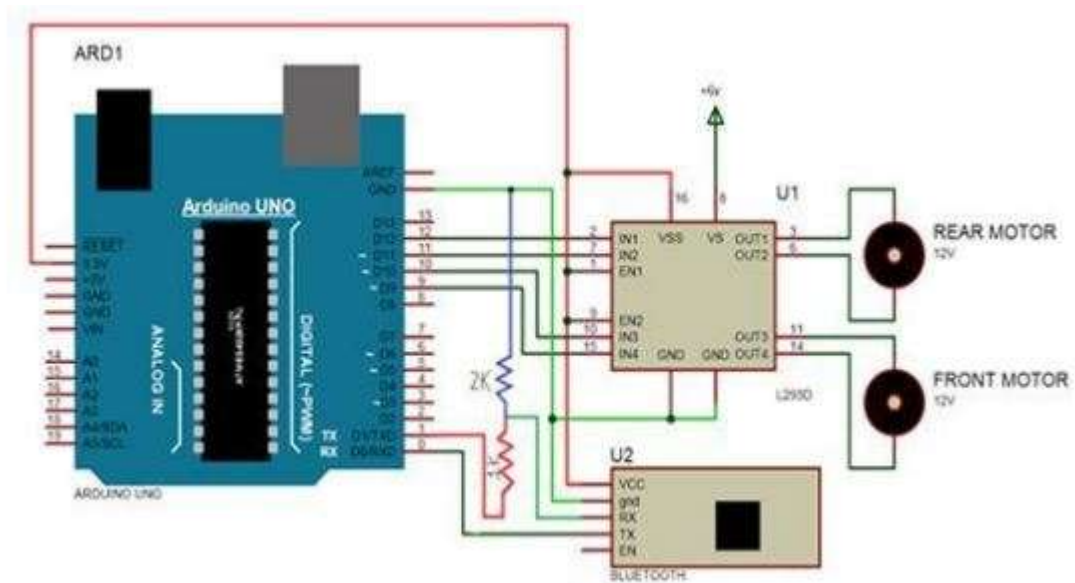


Figure 24: Schematic diagram for motor drive module - The diagram shows how the arduino helps control the vehicle motors for traversing directions by supplying and holding back voltage at respective ends

4.2.1 Features of L298N

- High working voltage can be up to 40 volts. Drive voltage: 5-35V; rationale voltage: 5V.
- It can provide a large output current and the peak surge current can be up to 3A with a power estimation of 25W.
- Uses standard rationale level sign to control and can easily drive a tow or four-stage stepper motor and also two-stage DC motors.
- Implements a freewheeling diode and a high-limit capacitor for channeling that essentially shields components that are parts of the circuit from being affected by the opposite current whenever there is an inductor related load, upgrading unwavering quality
- It has the ability to use the implicit 'stabilivolt' tube 78M05 in order to obtain a 5v voltage from the force supply. But to guard the chip of the 78M05 from any potential harm like in

the case when the input voltage exceeds the 12v voltage, an outside 5v rationale is flexibly initialized.

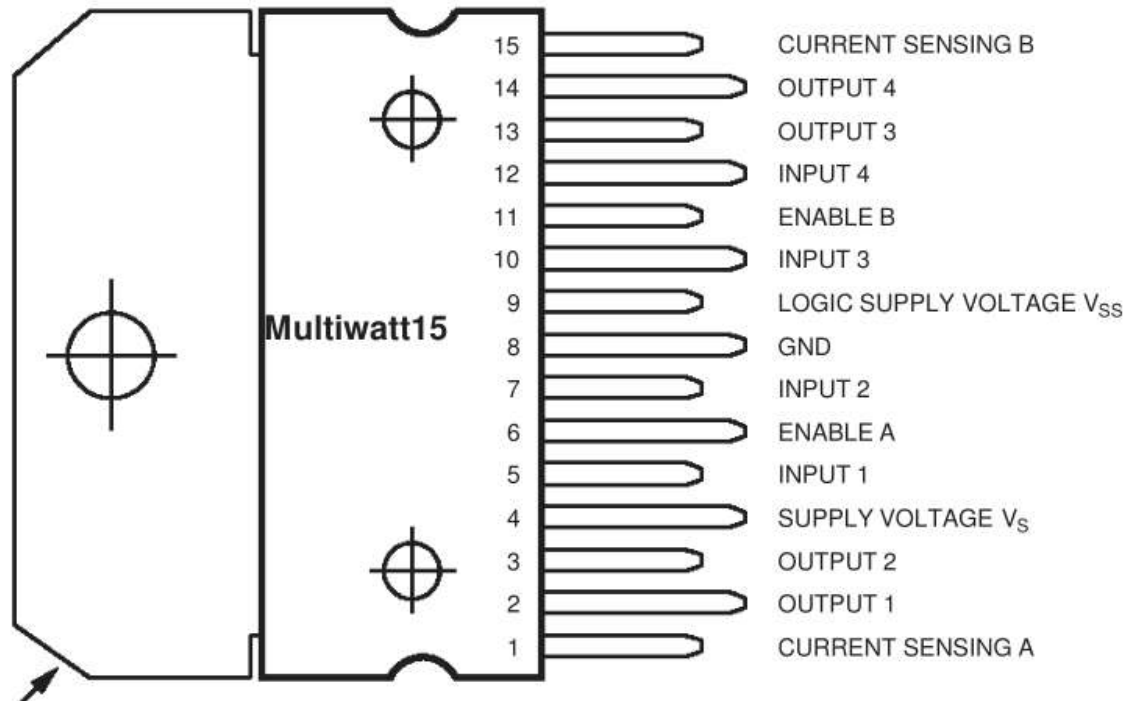


Figure 25: Multi-watt 15 pin function

4.2.2 Principle of Working

This driver module has the capacity to drive two engines. The empowered terminals represented as the ENA and ENB are powerful at elevated level. The table below shows the control mode and application of the engine:

ENA↵	IN1↵	IN2↵	The State of DC Motor A↵
0↵	X↵	X↵	Stop↵
1↵	0↵	0↵	Brake↵
1↵	0↵	1↵	Rotate Clockwise↵
1↵	1↵	0↵	Rotate Counterclockwise↵
1↵	1↵	1↵	Brake↵

To control the speed of engine A by PWM, we have to set IN1 and IN2, affirm the rotational heading of the engine, and afterward yield PWM beats for empowered terminals. If you don't mind note the engine is within the free stop state when the sign of empowered terminal is 0. At the point when the empowered sign is 1, if IN1 and IN2 are 00 or 11, the engine is in brake state, and in this manner the motor quits turning. On the off chance that IN1 is 0 and IN2 is 1, the engine A pivots clockwise; if IN1 is 1 and IN2 is 0, the engine A turns counterclockwise. This clarifies the control strategy for engine A. Likewise, the control strategy for engine B is only equivalent to that for engine A.

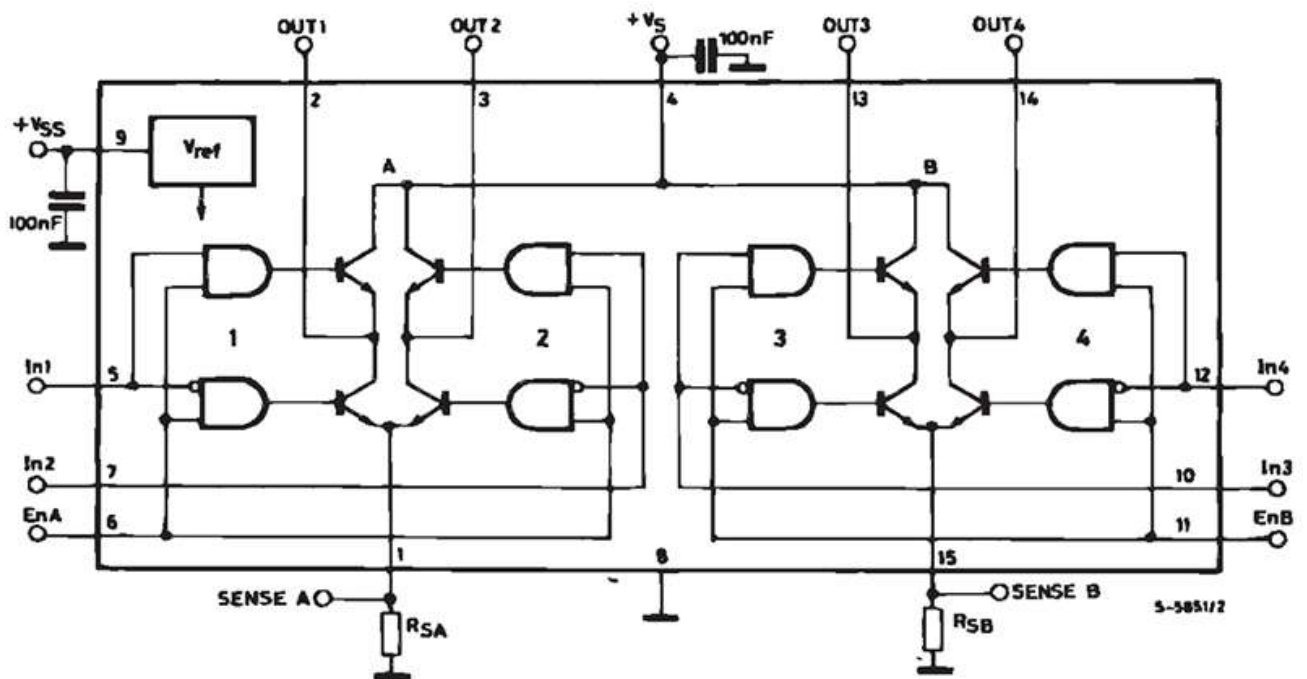


Figure 26: Driver Module Block Diagram

4.3 Bluetooth Module HC-05

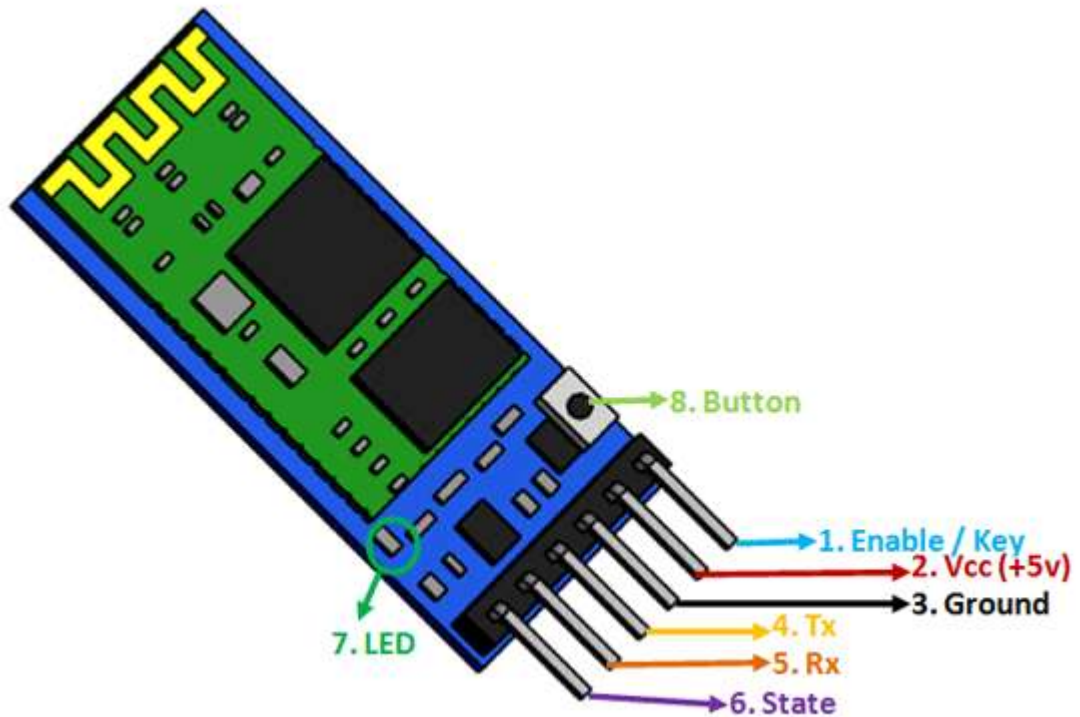


Figure 27: HC-05 Bluetooth Module

HC- 05 bluetooth module is intended for straightforward remote sequential association arrangement and is among the easiest to use BluetoothSerial Port Protocol modules. These modules are frequently used during a Master or Slave setup, making it a wonderful candidate when it comes to remote response. This interface module might even be a perfectly viable Bluetooth with Enhanced Data Rate 3 Mbps Modulation accompanied by a whole 2.4GHz baseband and a radio handset. It makes use of CSR Bluecore 04- External single-chip Bluetooth framework along with the new CMOS technology and furthermore uses AFH (Adaptive Frequency Hopping).^[15]

4.3.1 Pin Configuration

Pin Number	Pin Name	Description
1	Enable / Key	This pin is employed to toggle between Data Mode (set low) and AT command mode (set high). By default it's in Data mode
2	Vcc	Powers the module. Hook up with +5V Supply voltage
3	Ground	Ground pin of module_ connects system to ground.
4	TX Transmitter	– Transmits Serial Data. Everything received via Bluetooth is going to be given out by this pin as serial data.
5	RX Receiver	– Receive Serial Data. Every serial data given to the present pin will be broadcast via Bluetooth
6	State	The state pin is connected to on board LED, it is often used as a feedback to check if Bluetooth is functioning properly.
7	LED	Indicates the status of Module <ul style="list-style-type: none"> • Blink once in 2 sec: Module is in Command Mode • Repeated Blinking: Expecting connection in Data Mode • Blink twice in 1 sec: Module Connected in Data Mode

4.3.2 HC-05 Technical Specifications

- Serial Bluetooth module for Arduino and other microcontrollers
- Operating Voltage: 4V to 6V (Typically +5V)
- Operating Current: 30mA
- Range: <100m
- Works with Serial communication (USART) and TTL compatible
- Follows IEEE 802.15.1 standardized protocol
- Uses Frequency-Hopping Spread spectrum (FHSS)
- Can operate in Master, Slave or Master/Slave mode
- Can be easily interfaced with Laptop or Mobile phones with Bluetooth
- Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.

4.3.3 Using the Bluetooth module HC-05

The Bluetooth module HC-05 presents two potential working modes namely, Data mode wherein the module can transmit as well as intake info from other nearby Bluetooth devices where as the another is called the AT Command mode which is utilized to modify the default gadget settings. The device can be operated in both of the described modes with the assistance of the key pin as shown in the pin layout.

It is anything but difficult to connect this bluetooth module with the microcontrollers because of the way that it functions utilizing what is known as the Serial Port Protocol (SPP). To operate the module with a voltage of +5V match the Tx pin to Rx of MCU and the Rx pin of the bluetooth module to the Tx of MCU :

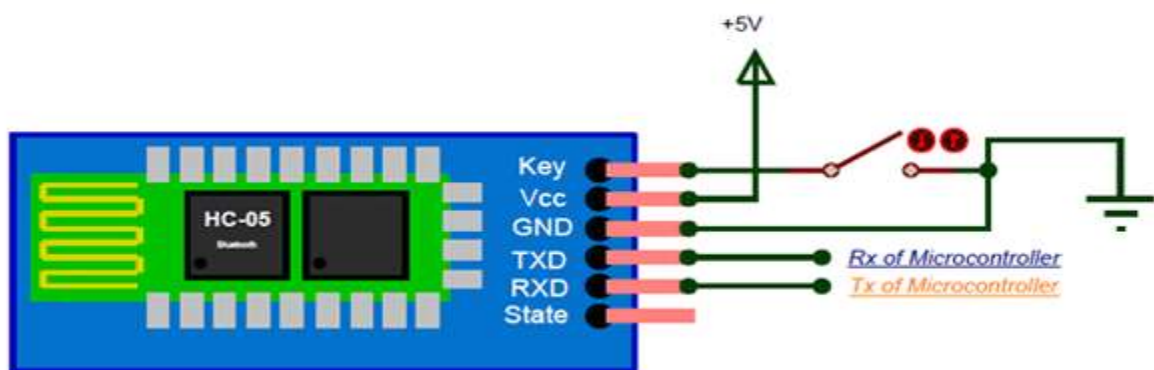


Figure 28: HC-05 pairing with microcontrollers

During power up establishing the key pin goes into Command mode but when it is left idle it can also go into the information mode. Once it is fueled we will see the option to find it under nearby Bluetooth devices under the name of "HC-05" where we can connect with it by entering the default password "1234" to begin sharing information with it.

4.3.4 Applications

The HC-05 can likewise empower two-way (full-duplex) implementations remotely. It tends to find applications in conveying data among a pair of micro-controllers, for example an Arduino based instrument connected with some other Bluetooth based device like a PC or phone. A number of android operated applications are essentially accessible making the process impressively simpler. The module conveys by utilizing USART at 9600 baud rate along these lines its easy to interface it with a microcontroller as long as it has the capacity to help USART. Aside from this in the same manner we can design the default presets of the described module by entering and utilizing the order mode. Even if there is a chance that you are searching for a Wireless module for transmitting or sharing information from your cell phone or PC to a micro-controller then making use of this module can prove to be a good idea. But at the same time don't expect it to send data like sound or pictures.

- Wireless communication between two micro-controllers
- Communication with Laptop, PC and mobile phones
- Data Logging application
- Consumer related applications
- Wireless Robots
- Home Automation

4.4 DC Gear Motors



Figure 29: 3-6 V Gear Motor

Gear motors are utilized in applications that require higher torque yield with lower shaft speed. This depicts a wide scope of utilizations and situations, including a large number of the machines and gear we collaborate with every day. Gear engines are utilized to control a critical number of machines and applications from ATV wipers to medical clinic beds, servo components to bundling hardware and paint blenders to juice containers.

Laying out plainly, a rigging engine is an electric engine combined with an apparatus train. To constrain the speed of the engine's pole, and increment the engine's capacity to yield torque, by and large, the expansion of a gearbox is proposed. Gears really convert shaft speed into torque at specific proportions, alongside least misfortunes, making it conceivable to make the perfect torque yield and speed by including the suitably estimated and arranged gearbox.

4.4.1 Basic Principles of Operation

A gear engine is of two sorts, it tends to be either an Alternating Current or a Direct Current. Some types of these motors can even have high frequencies like 1200 to 3600 revolutions per minute. These motors additionally exhibit two distinctive speed determinations: ordinary speed and the slow down speed torque specifications^[16]

Apparatus engines are for the most part utilized in lowering speed in a blend of gear that in turn generates higher torque. To realize this, a coordinated arrangement of gear or a gearbox is appended to the essential rotor and its shaft during a time decrease shaft. The next shaft is then joined with the gearbox to shape what is known as a series of step down gears.

When all is said in done, the bigger the quantity of decrease equips, the lower the yield of the end rigging will be.

A fantastic yet basic example of this specific rule is the hour, minute and second hands electric time clock. The motor used to run such time clocks generally rotate at about 1500 cycles per minute. In order to bring this down, a series of decrease gears are utilized to hinder the advancement of the hands to work in synchronization on the clock for the correct time.

For example, while the rotor is spinning nearly at 1,500 cycles for every minute, this is the place the decrease gears become possibly the most important factor and make it feasible for the previously occurring rigging to turn at just one step for each minute. This is what empowers it to perform one full cycle for every minute on the objective of the said clock.

4.4.2 Gear Motors and Increased Force

Gear motors are primarily utilized in business applications that require a bit of gear or machine to have the option to apply a more prominent measure of power so as to move a substantial article. Instances of these sorts of hardware are the crane or the lift jack.

The electric engine utilized in many cranes is a sort of apparatus engine that utilizes the essential standards of speed decrease to broaden torque or power.

Gear engines applied in cranes are for the most part forte sorts that utilization almost no rotational yield speed so as to make mind boggling measures of torque. Be that as it may, the standards of the rigging engine utilized in a crane are actually equivalent to those referenced in the case of the electric time clock. The yield speed of the rotor is brought down with the assistance of a cascade of enormous gear until the rotation speed of the very last gear is low enough. This decreased value of RPM speed assists with making inapparently enormous amounts of power that can be in tuern operated to lift and move overwhelmingly heavy and large objects.

Chapter 5

CONCLUSION

In the course of development of this project we have examined the working and concepts of inductor based metal detectors. We have examined the different types of metal detectors and given emphasis to one implemented with the help of Arduino technology.

The fact that the prototype is Arduino based, makes it flexible relating to the types and values of inductor and capacitors used considering the ease by which we can reprogram or tweak the Arduino code.

The prototype serves as a base, allowing us to create room for further realization of ideas in the near future, while also acquainting us with how Arduino works and behaves under different circumstances. We are hopeful of successful implementation of the same prototype by combining it with the Bluetooth operated vehicle.

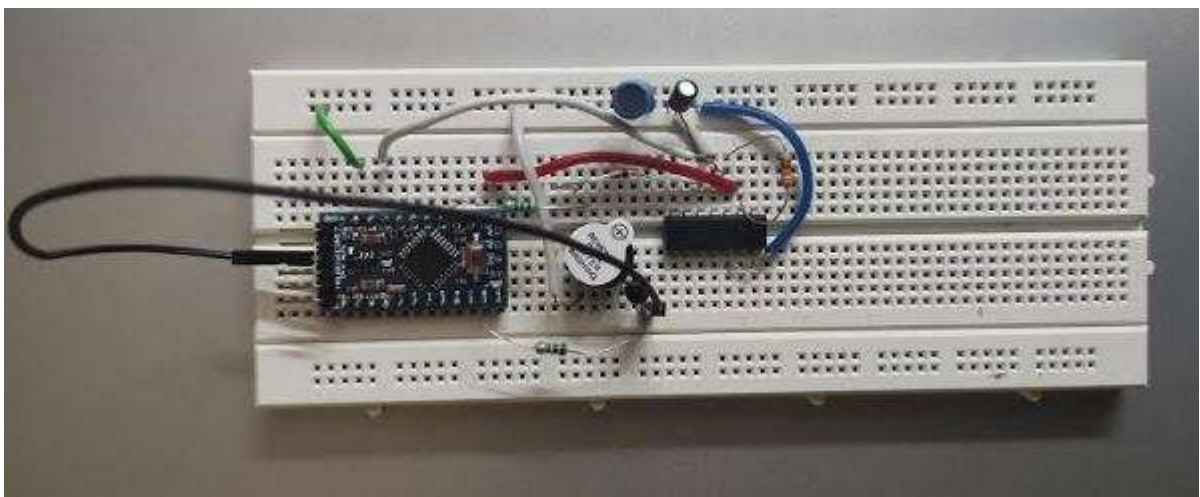
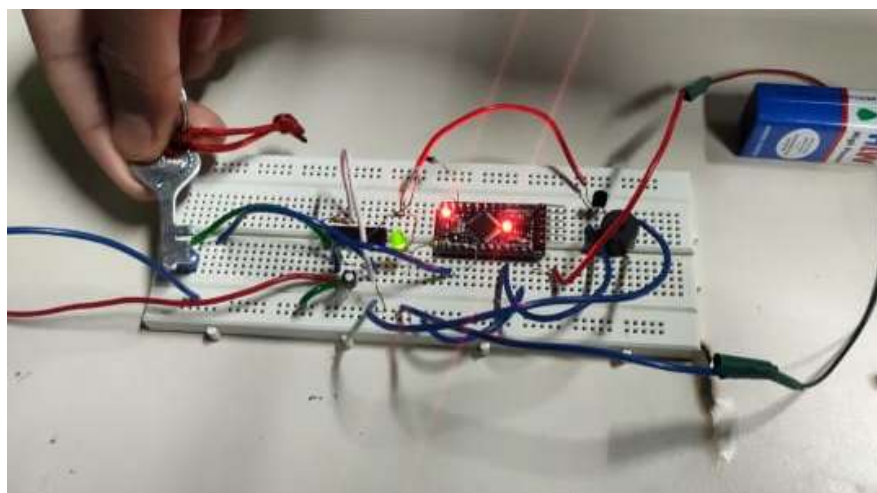


Figure 30 (a) and (b): Practically implemented Metal Detector Circuit



REFERENCES

- [1] “LC Oscillator Basics”
Available: <https://www.electronicshub.org/lc-oscillator-basics/>
[Accessed: 18-Nov-2019]
- [2] “Demining”
Available: <https://en.wikipedia.org/wiki/Demining>
[Accessed: 18-Nov-2019]
- [3] “Metal Detector – History of Metal Detector” Available:
https://www.softschools.com/inventions/history/metal_detector_history/376/ [Accessed:
18-Nov-2019]
- [4] “Metal Detector and Scanning”
Available: <https://nexussafety.net/metal-detector-scanning/>
[Accessed: 19-Nov-2019]
- [5] “How a metal detector works”
Available: <https://micro.magnet.fsu.edu/electromag/java/detector/index.html>
[Accessed: 19-Nov-2019]
- [6] “Countries With The Most Landmines”
Available: <https://listverse.com/2008/08/11/10-countries-with-the-most-landmines/>
[Accessed: 20-Nov-2019]
- [7] “1N4148 Diode”
Available: <https://www.theengineeringprojects.com/2017/06/introduction-to-1n4148.html>
[Accessed: 21-Nov-2019]
- [8] “LM339 – Voltage Comparator IC” Available:
<https://components101.com/ics/lm339-pinout-features-datasheet> [Accessed: 23-
Nov-2019]
- [9] “BC548 NPN General Purpose Transistor”
Available: <https://www.electronics.com.bd/BC548-parts-IC-module-sensor>
[Accessed: 23-Nov-2019]
- [10] “Arduino Pro Mini”
Available: <https://www.arduino.cc/en/pmwiki.php?n=Main/ArduinoBoardProMini>
[Accessed: 24-Nov-2019]
- [11] “Getting started with Arduino Uno”
Available: <https://www.arduino.cc/en/Guide/ArduinoUno>
[Accessed: 11-Mar-2020]
- [12] “Using the Arduino Pro Mini 3.3V”
Available: <https://learn.sparkfun.com/tutorials/using-the-arduino-pro-mini-33v/all>
[Accessed: 11-Mar-2020]

- [13] “Arduino uno rev3”
Available: <https://store.arduino.cc/usa/arduino-uno-rev3>
[Accessed: 12-Mar-2020]
- [14] “Motor Driver Module L298N”
Available: http://wiki.sunfounder.cc/index.php?title=Motor_Driver_Module-L298N
[Accessed: 12-Mar-2020]
- [15] “HC-05 Bluetooth Module”
Available: <https://components101.com/wireless/hc-05-bluetooth-module>
[Accessed: 13-Mar-2020]
- [16] “How a gear motor works”
Available: <https://www.doityourself.com/stry/how-a-gear-motor-works>
[Accessed: 13-Mar-2020]

APPENDIX

Arduino Pro Mini Source Code

```
double pulse;

void setup(){
    pinMode(8, OUTPUT);    //configure pin 8 as output
    pinMode(11, INPUT);   //configure pin 11 as input
}

void loop(){ //loop for flashing the LED
    digitalWrite(13,HIGH)    //keep pin 13 high
    delayMicroseconds(5000); //wait for 5 seconds
    digitalWrite(13,LOW);   //turn off pin 13
    delayMicroseconds(100); //wait for 0.1 second
    pulse = pulseIn(11, HIGH, 5000); //create a pulse value based on the presence of metal
    if(pulse>920)           //920 is based on the time period
    {
        tone(8,1);         //activate tone
        delay(3000);       //continue tone for 3 seconds
        noTone(8);         //deactivate tone
    }
}
```

Arduino Uno Rev3 Source Code

```
char x;

void setup() {
  pinMode(9,OUTPUT); //configure pin 9 as output
  pinMode(10,OUTPUT); //configure pin 10 as output
  pinMode(11,OUTPUT); //configure pin 11 as output
  pinMode(12,OUTPUT); //configure pin 12 as output
  pinMode(13,OUTPUT); //configure pin 13 as output
  Serial.begin(9600);
}
void loop() {
  if(Serial.available()){ //check the number of available for reading
  x = Serial.read(); //if same as what has been read
  Serial.println(x); //print x
  }

  if(x == 'F'){
  digitalWrite(11,HIGH); //activate pin 11
  digitalWrite(13,HIGH); //activate pin 13
  }

  else if(x == 'B'){
  digitalWrite(10,HIGH); //activate pin 10
  digitalWrite(12,HIGH); //activate pin 12
  }

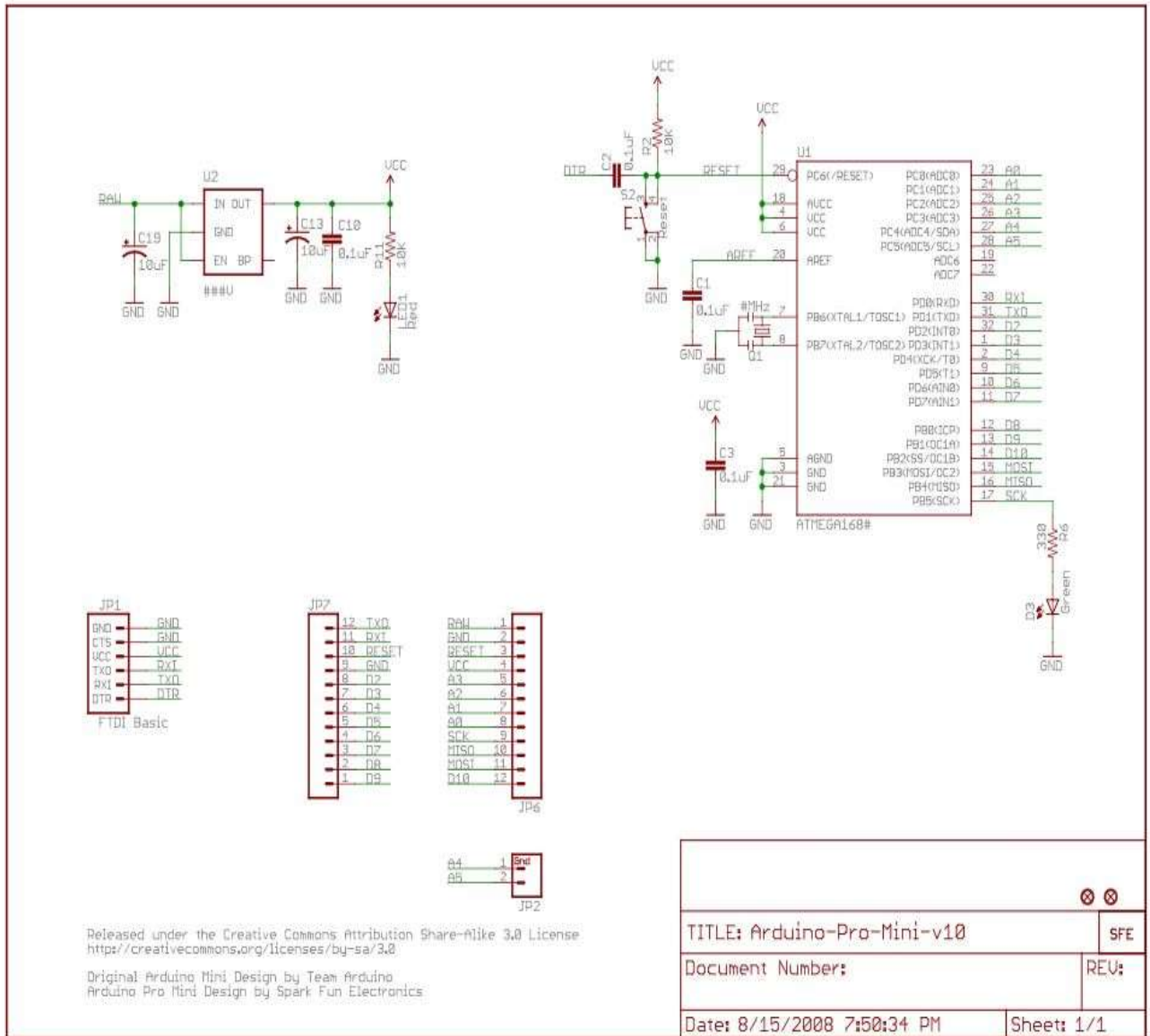
  else if(x == 'L'){
  digitalWrite(11,HIGH); //activate pin 11
  }

  else if(x == 'R'){
  digitalWrite(13,HIGH); //activate pin 13
  }

  else if(x == 'W'){
  digitalWrite(9,HIGH); //activate pin 9
  }
  else if(x == 'w'){
  digitalWrite(9,LOW); //activate pin 9
  }

  else if(x == 's'){
  digitalWrite(10,LOW); //deactivate pin 10
  digitalWrite(11,LOW); //deactivate pin 11
  digitalWrite(12,LOW); //deactivate pin 12
  digitalWrite(13,LOW); //deactivate pin 13
  }
  delay(100); }
```

Arduino Pro Mini Datasheet as provided by www.electronicdatasheets.com

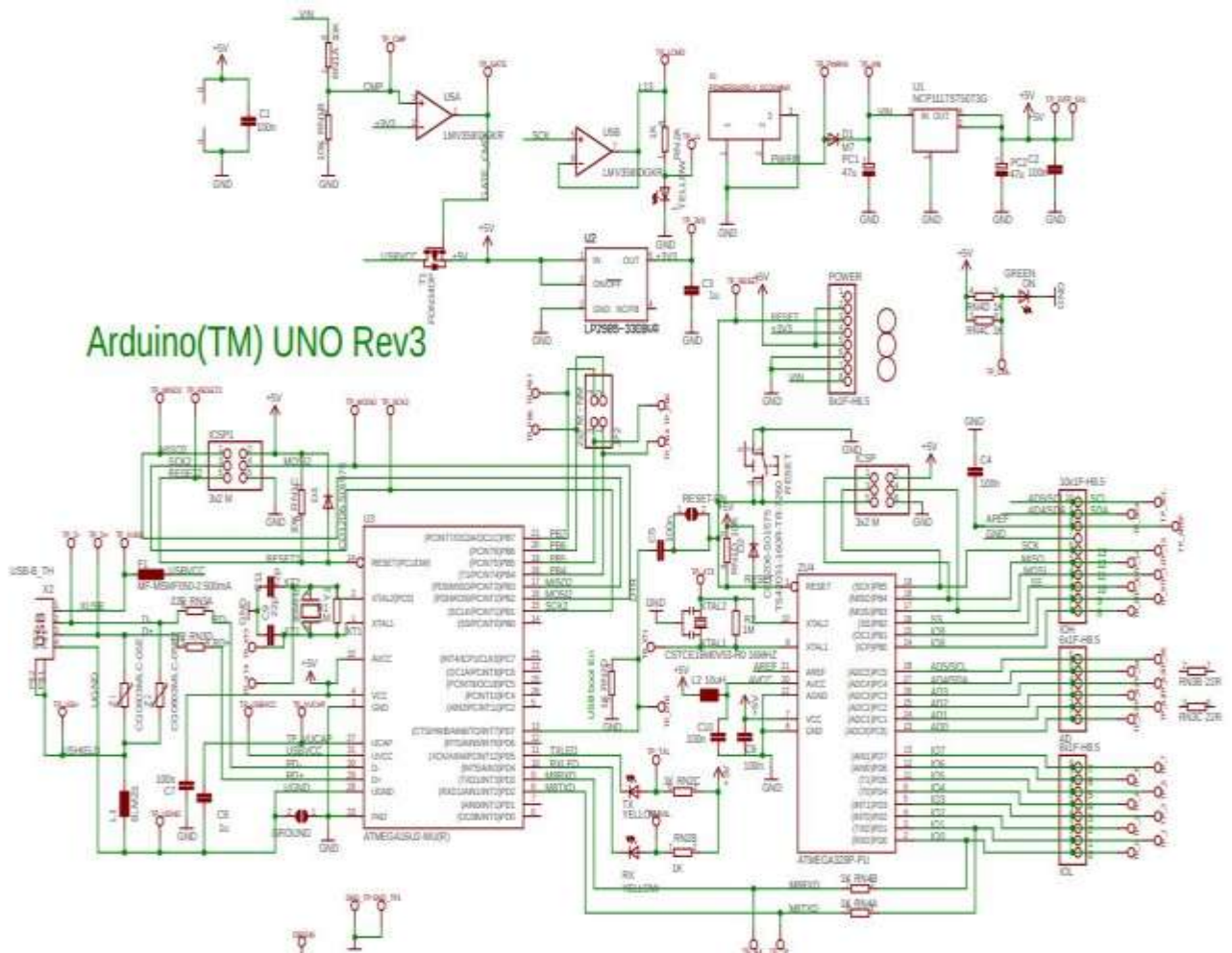


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Original Arduino Mini Design by Team Arduino
 Arduino Pro Mini Design by Spark Fun Electronics

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