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Design & Construction of Pipeline Inspection & Rescue Robot

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ABSTRACT: The project aims in designing "Robot to rescue of a child in a borehole" which is capable of moving inside the pipe according to the user commands given from PC. The project also used for Picking and Placing of objects based on arm design. The robot is operated through PC using wireless Zigbee technology and using wireless camera you can view both audio and video on the TV. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. It is a low cost robot used to monitor the changes of different parameters in the industrial pipes. The advent of new high-speed technology and the growing computer Capacity provided realistic opportunity for new robot controls and realization of new methods of control theory. This technical improvement together with the need for high performance robots created faster, more accurate and more intelligent robots using new robots control devices, new drivers and advanced control algorithms. This project describes a new economical solution of robot control systems. The presented robot control system can be used for different sophisticated robotic applications. The robot is operated through PC using wireless Zigbee technology and using wireless camera you can view both audio and video on the TV. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. It is a low cost robot used to monitor the changes of different parameters in the industrial pipes. Zigbee is a PAN technology based on the IEEE 802.15.4 standard. Unlike Bluetooth or wireless USB devices, Zigbee devices have the ability to form a mesh network between nodes. Meshing is a type of daisy chaining from one device to another. This technique allows the short range of an individual node to be expanded and multiplied, covering a much larger area.

I. INTRODUCTION

The paper aims in designing "Robot to rescue of a child in a borehole" which is capable of moving inside the pipe according to the user commands given from PC. The project also used for Picking and Placing of objects based on arm design. The robot is operated through PC using wireless Zigbee technology and using wireless camera you can view both audio and video on the TV. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. It is a low cost robot used to monitor the changes of different parameters in the industrial pipes.

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The robot is operated through PC using wireless Zigbee technology and using wireless camera you can view both audio and video on the TV. This robot has a high power LED which acts as a light source when light intensity inside the pipe is low. It is a low cost robot used to monitor the changes of different parameters in the industrial pipes. Zigbee is a PAN technology based on the IEEE 802.15.4 standard. Unlike Bluetooth or wireless USB devices, Zigbee devices have the ability to form a mesh network between nodes. Meshing is a type of daisy chaining from one device to another. This technique allows the short range of an individual node to be expanded and multiplied, covering a much larger area.

The controlling device of the whole system is a Microcontroller. Whenever the user presses a button from the keyboard of the PC, the data related to that particular button is sent through Zigbee module interfaced to PC. The robot also has arm to lift the obstacle using servo motor. The system also has head lamp vision with high power LED's and it gets ON when the LDR sensor detects the darkness inside the bore hole. This data will be received by the Zigbee module in the robot system and feds this to Microcontroller which judges the relevant task to the information received and acts accordingly on the robot and arm movement. The live images from the camera in the robot system can be sent to TV through AV transmitter system. The Microcontrollers used in the project are programmed using Embedded C language.

The objectives of the project include:

1. Wireless controlling of Robot through PC using Zigbee technology.
2. Live Audio and video can be seen on TV.
3. Implementation of pick and place concept to the robot.
4. DC motor based gripper operation for robotic arm.

Paper Overview:

Microprocessors are commonly referred to as general purpose processors as they simply accept the inputs, process it and give the output. In contrast, a microcontroller not only accepts the data as inputs but also manipulates it, interfaces the data with various devices, controls the data and thus finally gives the result.

The paper "DESIGN & CONSTRUCTION OF PIPELINE INSPECTION & RESCUE ROBOT" using 16F877A Microcontroller is an exclusive project that can move the robot according to the instructions given by the above said microcontroller. The system also has a camera that is fixed to the Robot; this project enables the user to capture the image in any direction using a wireless camera which is connected to a robot that can move with the speed and direction specified by the user.

1.3 paper Overview:

The paper explains the implementation of "DESIGN & CONSTRUCTION OF PIPELINE INSPECTION & RESCUE ROBOT" using 16F877A microcontroller. The organization of the thesis is explained here with:

II. LITERATURE SURVEY

Introduction: Deterioration of underground pipe infrastructure is a well documented fact. Even though, they are the most basic resources sustaining urban life this underground network has largely been ignored, mostly due to the fact that it is invisible to the general public. The majority of the current underground pipe infrastructure was built over 50 years ago and is closed to the end of its design life. Recently the deterioration of this system has become a considerable financial burden to utility owners. Rehabitation of the waste water system requires extensive capital investments and the allocation of scarce resources must be prioritized. This leads decision makers to implement proactive preventative maintenance procedures. Proactive Asser management allows utility owners to plan and schedule the inspection and rehabilitation of critical utilities prior to the occurrence of emergency scenarios. One of the most promising new quantitative pipe inspection and asset management methods is the in-pipe application of ground penetrating radar (GPR).

Pipe penetrating radar fundamentals: First, pipe penetrating radar (PPR) is the underground in pipe application of ground penetrating radar. The ppr pulse travels through a pipe material as a function of its electrical properties which are in turn a function of the materials chemical and physical composition. Some of the pulse will also reflected and refracted by any sharp change in material properties, such as at the interface between physical combination of

An embedded system is a combination of software and hardwar

These reflected waves are detected by receiving antenna and recorded as a single trace. This process is repeated continuously as the antenna is moved along a survey line to build up an entire profile along the survey line. The radar gram image is a display of transit time vs distance travelled, with amplitude displayed either as wiggle trace or colour scale. the recorded reflection can be then analyzed in terms of their shape, travel time and signal amplitude and phase.

Development of pipe penetrating radar (ppr): Before starting in 2002 new user friendly hardware and corresponding processing programs allowed non specialists to efficiently operate high frequency GPR systems that in turn made the technique feasible to operate within a pipe to provide for void detection and condition assessment of infrastructure that is nearing its safe service life. Early ppr attempts used rudimentary project specific hardware that confirmed the viability of the technique. Below is a condensed history of in pipe GPR in north America.

In 2004, the city of phonix approved a pilot project using a combined GPR and digital scanning and evaluation technology (DSET) system. The use of GPR combined with SET was found to be promising for detecting defects in concrete pipe wall behind the PVC liner speculated that as this technology advances it could have other application

Including the assessment of reinforcing bars within a pipe wall and determination of pipe wall thickness. in 2005 ,GPR was used to assess the tunnel lining condition and locate concrete deterioration and voids in the 9km long kapoor water tunnel, Victoria, BC, Canada, using a GPR system mounted on a custom built cart.

The sewer VUE surveyor PPR system: Standard "above ground "data collection techniques can be utilises in pipe inspection when manned entry is feasible or when the pipe is exposed. Running a remotely controlled GPR survey in an underground pipe creates special challenges, since the commercially available systems are not designed to transmit data over long distances, the length of the data cable is typically metres.

The sewervue surveyor provides quantifiable results such as pipe wall thickness and rebar cover for buried infrastructure structural condition assessments. Pan/tilt/zoom CCTV completes the multi-sensor inspection (MSI) package on the surveyor and provides for a visual, standard coded reference commonly accepted as the minimum in any condition assessment.

Data display and interpretation: The objective of PPR data presentation is to provide a display of the processed data that closely approximates an image of the pipe and its bedding material with anomalies that are associated with the objectives of interest in their proper spatial positions. Producing a good display as an integral part of interpretation,

There are five types of data display:

1) One dimensional trace
2) Two dimensional cross section
3) Two dimensional depth slice
4) A three dimensional display
5) An integrated pipe penetrating radar data display(IPPRDD)

Three dimensional displays are fundamentally block views of PPR traces that are recorded at different positions on the pipe surface. Data are usually collected along profile lines, the accurate location of each trace is critical to producing accurate 3D displays. Normally, 3D block views are constructed, then they may be viewed in a variety of ways, including as solid block or as block slices or as animated transparent 3D objects.

Obtaining a good three dimensionally display is a critical part of interpreting PPR data. Targets of interest are generally easier to identify and isolate on three dimensional data sets than two dimensional profile lines. simplifying the image by eliminating the noise and clutter is the most important factor for optimizing the interpretation. The first commercially available integrated "pipe penetrating radar data interpretation application(PP-RADIAN0" data processing and display package was released in march 2010 by sewerVUE technology corp. This application allows 3D visualization of key pipe attributes such as pipe wall thickness, substrate voids and rebar configuration i reinforced concrete pipes.PP-RADIAN splices individual radar scan lines into a partially corrected 3D representation, which can be viewed at 1/16 inch depth intervals.

This approach allows the display of the highest theoretical resolution of GPR data possible, to provide confident assessment of joint configuration , pipe wall thickness and rebar cover.

In reporting function the PPR results are displayed with the interpretation superimposed on the actual depth profiles versus distance. The top two lines show the individual PPR profiles with the corresponding clock position and antenna frequency denoted with an icon to the left of the corresponding profile. The scales are in inches. The location of the scan lines are marked on the foldout view of the pipe at the bottom of each pipe segment with the corresponding clock positions on the vertical axis. Anomalies and other notable features are colour coded. Vertical dashed lines denoted the location of the pipe cross sections. the cross sectional view of the pipe shows the interpreted pipe wall thickness and other pertinent information at the given change together with foldout view of the pipe.

Embedded systems: An embedded system is a computer system designed to perform one or a few dedicated functions often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today.

Embedded systems are controlled by one or more main processing cores that are typically either microcontrollers or digital signal processors (DSP). The key characteristic, however, is being dedicated to handle a particular task, which may require very powerful processors. For example, air traffic control systems may usefully be viewed as embedded, even though they involve mainframe computers and dedicated regional and national networks between airports and radar sites. (Each radar probably includes one or more embedded systems of its own.)

Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Physically embedded systems range from portable devices such as digital watches and MP3

players, to large stationary installations like traffic lights, factory controllers, or the systems controlling nuclear power plants. Complexity varies from low, with a single microcontroller chip, to very high with multiple units, peripherals and networks mounted inside a large chassis or enclosure.

In general, "embedded system" is not a strictly definable term, as most systems have some element of extensibility or programmability. For example, handheld computers share some elements with embedded systems such as the operating systems and microprocessors which power them, but they allow different applications to be loaded and peripherals to be connected. Moreover, even systems which don't expose programmability as a primary feature generally need to support software updates. On a continuum from "general purpose" to "embedded", large application systems will have subcomponents at most points even if the system as a whole is "designed to perform one or a few dedicated functions", and is thus appropriate to call "embedded". A modern example of embedded system is shown in fig: 2.1.

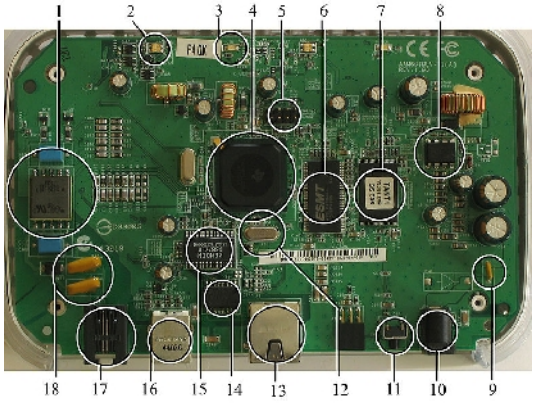


Fig. 1. A modern example of embedded system

Labeled parts include microprocessor (4), RAM (6), flash memory (7).Embedded systems programming is not like normal PC programming. In many ways, programming for an embedded system is like programming PC 15 years ago. The hardware for the system is usually chosen to make the device as cheap as possible. Spending an extra dollar a unit in order to make things easier to program can cost millions. Hiring a programmer for an extra month is cheap in comparison. This means the programmer must make do with slow processors and low memory, while at the same time battling a need for efficiency not seen in most PC applications. Below is a list of issues specific to the embedded field.

REAL-TIME EMBEDDED SYSTEMS: Embedded systems which are used to perform a specific task or operation in a specific time period those systems are called as real-time embedded systems. There are two types of real-time embedded systems.

- Hard Real-time embedded systems:

These embedded systems follow an absolute dead line time period i.e.., if the tasking is not done in a particular time period then there is a cause of damage to the entire equipment.

Eg: consider a system in which we have to open a valve within 30 milliseconds. If this valve is not opened in 30 ms this may cause damage to the entire equipment. So in such cases we use embedded systems for doing automatic operations.

Eg: Consider a TV remote control system ,if the remote control takes a few milliseconds delay it will not cause damage either to the TV or to the remote control. These systems which will not cause damage when they are not operated at considerable time period those systems comes under soft real-time embedded systems.

INDUSTRIAL AUTOMATION: Today a lot of industries are using embedded systems for process control. In industries we design the embedded systems to perform a specific operation like monitoring temperature, pressure, humidity ,voltage, current etc.., and basing on these monitored levels we do control other devices, we can send information to a centralized monitoring station.

Fig. 2. Robot.

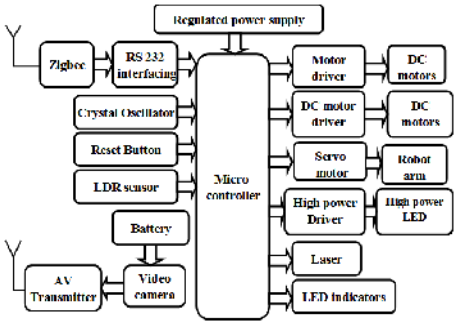
In critical industries where human presence is avoided there we can use robot**s** which are programmed to do a specific operation.

COMPUTER NETWORKING

Embedded systems are used as bridges routers etc.

Fig. 3. Computer networking

III. WORKING PRINCIPLE
WORKING OF HARDWARE DESCRIPTION:



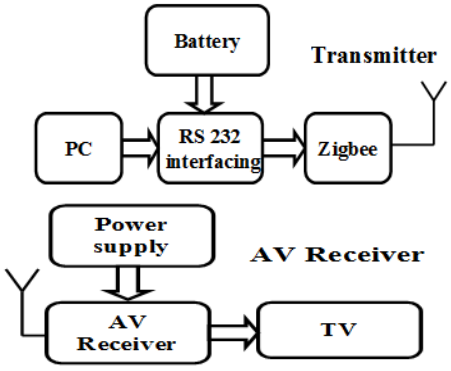


Fig. 4. Block diagram of AV Receiver.

Our project aim is to "Robot to rescue of a child in a bore hole" which is capable of moving inside the pipe according to the user commands given from PC. so now its working principal is we control our robot by using PC through wireless zigbee technology. zegbee will receive the commands from the PC then the zigbee will transfer these commands to pic micro controller. Then the pic microcontroller will control our robot for moving up and down.

Crystal oscillator is used in this project because of the fact that crystal is more stable to temperature then other types of oscillator. An oscillator is a tuned electronic circuit used to generate a continuous output wave form. Reset button is used to reset the microcontroller.

Bottom side of the robot we are connected one video camera from that we will watch live audio and video.We are using dc motor driver because of to maintain the constant voltage (5V).Actual dc motor is 12v because of that we are used Dc motor driver and we also using an servomotor that is connected to the robot gripper. Grippers having a two spur gear and one warm gear. when spur gear are rotates in clock wise direction the gripper arms are open. If spur gears are rotates in counter clockwise then gripper arms will be closed.

The main blocks of this project are:

1. Micro controller (16F877A)
2. Reset button
3. Crystal oscillator
4. Regulated power supply (RPS)
5. Led indicator
6. RS 232 cable
7. Zigbee module
8. DC Motors
9. DC motor driver
10. Wireless camera
11. High power LED

MICRO CONTROLLER:

Fig. 5. Microcontroller**s.**

INTRODUCTION TO MICROCONTROLLERS:

Circumstances that we find ourselves in today in the field of microcontrollers had their beginnings in the development of technology of integrated circuits. This development has made it possible to store hundreds of thousands of transistors into one chip. That was a prerequisite for production of microprocessors, and the first computers were made by adding external peripherals such as memory, input-output lines, timers and other. Further increasing of the volume of the package resulted in creation of integrated circuits.

These integrated circuits contained both processor and peripherals. That is how the first chip containing a microcomputer, or what would later be known as a microcontroller came about.

Microprocessors and microcontrollers are widely used in embedded systems products. Microcontroller is a programmable device. A microcontroller has a CPU in addition to a fixed amount of RAM, ROM, I/O ports and a timer embedded all on a single chip. The fixed amount of on-chip ROM, RAM and number of I/O ports in microcontrollers makes them ideal for many applications in which cost and space are critical.

The microcontroller used in this project is PIC16F877A. The PIC families of microcontrollers are developed by Microchip Technology Inc. Currently they are some of the most popular microcontrollers, selling over 120 million devices each year. There are basically four families of PIC microcontrollers:

PIC12CXXX 12/14-bit program word

PIC 16C5X 12-bit program word

PIC16CXXX and PIC16FXXX 14-bit program word

PIC17CXXX and PIC18CXXX 16-bit program word

The features, pin description of the microcontroller used are discussed in the following sections

MICROPROCESSOR VS. MICROCONTROLLER:

MICROPROCESSOR

- CPU is stand-alone, RAM, ROM, I/O, timer are separate
- Designer can decide on the amount of ROM, RAM and I/O ports.
- expansive
- versatility
- general-purpose

MICROCONTROLLER

- CPU, RAM, ROM, I/O and timer are all on a single chip
- fix amount of on-chip ROM, RAM, I/O ports
- for applications in which cost, power and space are critical

PRINCETONARCHITECTURE (SINGLE MEMORY INTERFACE):

Program memory and data memory are interfaced to CPU through common buses

An instruction "Read a data byte from memory and store it in the accumulator" is executed as follows: -

Cycle 1 - Read Instruction

Cycle 2 - Read Data out of RAM and put into Accumulator

It will take more time to execute instructions

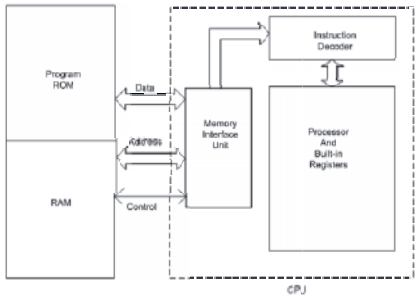


Fig. 6. Harvard Architecture (Separate Program and Data Memory interfaces**)**

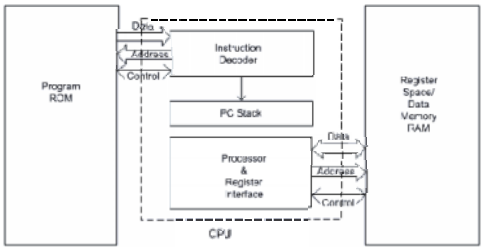


Fig. 7. Princeton Architecture

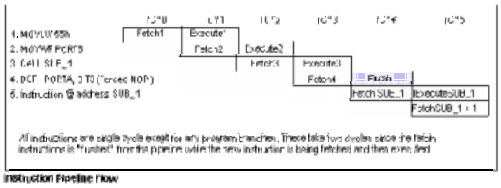
Hence each instruction is effectively executed in one instruction cycle, except for the ones that modify the content of the program counter. For example, the "jump" (or call) instructions takes 2 cycles. Thus, due to parallelism, Harvard architecture executes more instructions in a given time compared to Princeton Architecture.

PIC MICROCONTROLLERS:

PIC stands for Peripheral Interface Controller given by Microchip Technology to identify its single-chip microcontrollers. These devices have been very successful in 8-bit microcontrollers. The main reason is that Microchip Technology has continuously upgraded the device architecture and added needed peripherals to the microcontroller to suit customers' requirements. The development tools such as assembler and simulator are freely available on the internet at www.microchip.com .

PIPELINING

Instruction cycle consists of cycles Q1, Q2, Q3 and Q4. Cycles of calling and executing instructions are connected in such a way that in order to make a call, one instruction cycle is needed, and one more is needed for decoding and execution. However, due to pipelining, each instruction is effectively executed in one cycle. If instruction causes a change on program counter, and PC doesn't point to the following but to some other address (which can be the case with jumps or with calling subprograms), two cycles are needed for executing an instruction. This is so because instruction must be processed again, but this time from the right address. Cycle of calling begins with Q1 clock, by writing into instruction register (IR). Decoding and executing begins with Q2, Q3 and Q4 clocks.



TCY0 reads in instruction MOVLW 55h (it doesn't matter to us what instruction was executed, because there is no rectangle pictured on the bottom).
TCY1 executes instruction MOVLW 55h and reads in MOVWF PORTB.
TCY2 executes MOVWF PORTB and reads in CALL SUB_1.
TCY3 executes a call of a subprogram CALL SUB_1, and reads in instruction BSF PORTA, BIT3. As this instruction is not the one we need, or is not the first instruction of a subprogram SUB_1 whose execution is next in order, instruction must be read in again. This is a good example of an instruction needing more than one cycle.
TCY4 instruction cycle is totally used up for reading in the first instruction from a subprogram at address SUB_1.
TCY5 executes the first instruction from a subprogram SUB_1 and reads in the next one.

PIN DESCRIPTION

CLOCK GENERATOR – OSCILLATOR

Oscillator circuit is used for providing a microcontroller with a clock. Clock is needed so that microcontroller could execute a program or program instructions.

TYPES OF OSCILLATORS

PIC16Fcan work with four different configurations of an oscillator
Since configurations with crystal oscillator and resistor-capacitor (RC) are the ones that are used most frequently, these are the only ones we will mention here. Microcontroller type with a crystal oscillator has in its designation XT, and a microcontroller with resistor-capacitor pair has a designation RC.
This is important because you need to mention the type of oscillator when buying a microcontroller.

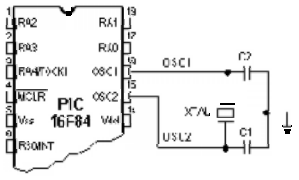


Fig. 8. Connecting the quartz oscillatro to give clock to a microcontroller

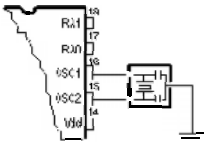
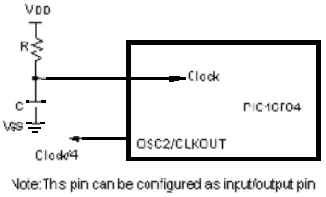


Fig. 9. Connecting a resonator onto a microcontroller.

XT Oscillator Crystal oscillator is kept in metal housing with two pins where you have written down the frequency at which crystal oscillates. One ceramic capacitor of 30pF whose other end is connected to the ground needs to be connected with each pin. Oscillator and capacitors can be packed in joint case with three pins. Such element is called ceramic resonator and is represented in charts like the one below. Center pins of the element is the ground, while end pins are connected with OSC1 and OSC2 pins on the microcontroller. When designing a device, the rule is to place an oscillator nearer a microcontroller, so as to avoid any interference on lines on which microcontroller is receiving a clock.

RC OSCILLATOR

In applications where great time precision is not necessary, RC oscillator offers additional savings during purchase. Resonant frequency of RC oscillator depends on supply voltage rate, resistance R, capacity C and working temperature. It should be mentioned here that resonant frequency is also influenced by normal variations in process parameters, by tolerance of external R and C components, etc.



Above diagram shows how RC oscillator is connected with PIC16F84. With value of resistor R being below 2.2k, oscillator can become unstable, or it can even stop the oscillation. With very high value of R (ex.1M) oscillator becomes very sensitive to noise and humidity. It is recommended that value of resistor R should be between 3 and 100k. Even though oscillator will work without an external capacitor (C=0pF), capacitor above 20pF should still be used for noise and stability. No matter which oscillator is being used, in order to get a clock that microcontroller works upon, a clock of the oscillator must be divided by 4. Oscillator clock divided by 4 can also be obtained on OSC2/CLKOUT pin, and can be used for testing or synchronizing other logical circuits.

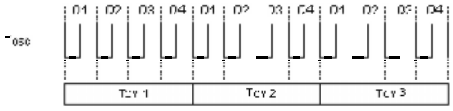


Fig. 10. Relationship between a clock and a number of instruction cycles

Following a supply, oscillator starts oscillating. Oscillation at first has an unstable period and amplitude, but after some period of time it becomes stabilized.

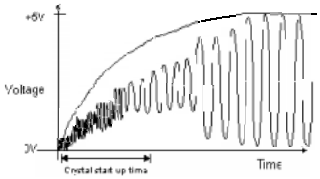


Fig. 11. Signal an oscillator clock after receiving the supply of a microcontroller

To prevent such inaccurate clock from influencing microcontroller's performance, we need to keep the microcontroller in reset state during stabilization of oscillator's clock. Diagram above shows a typical shape of a signal which microcontroller gets from the quartz oscillator.

RESET:

Reset is used for putting the microcontroller into a 'known' condition. That practically means that microcontroller can behave rather inaccurately under certain undesirable conditions. In order to continue its proper functioning it has to be reset, meaning all registers would be placed in a starting position. Reset is not only used when microcontroller doesn't behave the way we want it to, but can also be used when trying out a device as an interrupt in program execution, or to get a microcontroller ready when loading a program.

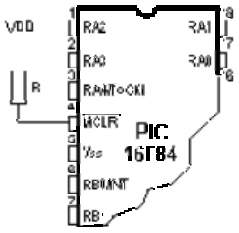


Fig. 12. Using the internal reset circuit

In order to prevent from bringing a logical zero to MCLR pin accidentally (line above it means that reset is activated by a logical zero), MCLR has to be connected via resistor to the positive supply pole. Resistor should be between 5 and 10K. This kind of resistor whose function is to keep a certain line on a logical one as a preventive, is called a pull up. Microcontroller PIC16F84 knows several sources of resets:

a) Reset during power on, POR (Power-On Reset)
b) Reset during regular work by bringing logical zero to MCLR microcontroller's pin.
c) Reset during SLEEP regime
d) Reset at watchdog timer (WDT) overflow
e) Reset during at WDT overflow during SLEEP work regime.

The most important reset sources are a) and b). The first one occurs each time a power supply is brought to the microcontroller and serves to bring all registers to a starting position initial state.

The second one is a product of purposeful bringing in of a logical zero to MCLR pin during normal operation of the microcontroller. This second one is often used in program development. During a reset, RAM memory locations are not being reset. They are unknown during a power up and are not changed at any reset. Unlike these, SFR registers are reset to a starting position initial state.

One of the most important effects of a reset is setting a program counter (PC) to zero (0000h), which enables the program to start executing from the first written instruction.

Reset at supply voltage drop below the permissible (Brown-out Reset). Impulse for resetting during voltage voltage-up is generated by microcontroller itself when it detects an increase in supply Vdd (in a range from 1.2V to 1.8V). That impulse lasts 72ms which is enough time for an oscillator to get stabilized. These 72ms are provided by an internal PWRT timer which has its own RC oscillator. Microcontroller is in a reset mode as long as PWRT is active. However, as device is working, problem arises when supply doesn't drop to zero but falls below the limit that guarantees microcontroller's proper functioning. This is a likely case in practice, especially in industrial environment where disturbances and instability of supply are an everyday occurrence. To solve this problem we need to make sure that microcontroller is in a reset state each time supply falls below the approved limit.

If, according to electrical specification, internal reset circuit of a microcontroller can not satisfy the needs, special electronic components can be used which are capable of generating the desired reset signal. Beside this function, they can also function in watching over supply voltage. If voltage drops below specified level, a logical zero would appear on MCLR pin which holds the microcontroller in reset state until voltage is not within limits that guarantee accurate performance.

REGULATED POWER SUPPLY:

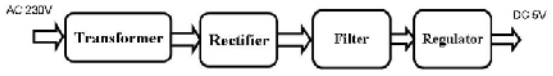


Fig. 13. Regulated Power Supply

The basic circuit diagram of a regulated power supply (DC O/P) with led connected as load is shown in fig

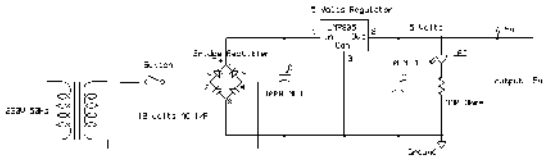


Fig 14. Circuit diagram of Regulated Power Supply with LED connection

The components mainly used in above figure are

- 230V AC MAINS
- TRANSFORMER
- BRIDGE RECTIFIER(DIODES)
- CAPACITOR
- VOLTAGE REGULATOR(IC 7805)
- RESISTOR
- LED(LIGHT EMITTING DIODE)

The detailed explanation of each and every component mentioned above is as follows:

TRANSFORMERS

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors without changing its frequency. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core, and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF) or "voltage" in the secondary winding. This effect is called mutual induction.

If a load is connected to the secondary, an electric current will flow in the secondary winding and electrical energy will be transferred from the primary circuit through the transformer to the load. This field is made up from lines of force and has the same shape as a bar magnet.

If the current is increased, the lines of force move outwards from the coil. If the current is reduced, the lines of force move inwards.

If another coil is placed adjacent to the first coil then, as the field moves out or in, the moving lines of force will "cut" the turns of the second coil. As it does this, a voltage is induced in the second coil. With the 50 Hz AC mains supply, this will happen 50 times a second. This is called MUTUAL INDUCTION and forms the basis of the transformer.

The input coil is called the PRIMARY WINDING; the output coil is the SECONDARY WINDING. Fig: 3.10 shows step-down transformer.

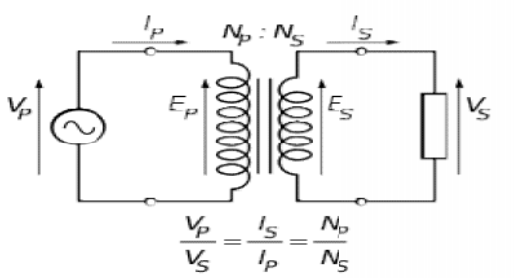


Fig. 15. Step-Down Transformer

The voltage induced in the secondary is determined by the TURNS RATIO.

$$\frac{\text{primary voltage}}{\text{secondary voltage}} = \frac{\text{number of primary turns}}{\text{number of secondary turns}}$$

For example, if the secondary has half the primary turns; the secondary will have half the primary voltage.

Another example is if the primary has 5000 turns and the secondary has 500 turns, then the turn's ratio is 10:1.

If the primary voltage is 240 volts then the secondary voltage will be x 10 smaller = 24 volts. Assuming a perfect transformer, the power provided by the primary must equal the power taken by a load on the secondary. If a 24-watt lamp is connected across a 24 volt secondary, then the primary must supply 24 watts.

To aid magnetic coupling between primary and secondary, the coils are wound on a metal CORE. Since the primary would induce power, called EDDY CURRENTS, into this core, the core is LAMINATED. This means that it is made up from metal sheets insulated from each other. Transformers to work at higher frequencies have an iron dust core or no core at all.

Note that the transformer only works on AC, which has a constantly changing current and moving field. DC has a steady current and therefore a steady field and there would be no induction.

Some transformers have an electrostatic screen between primary and secondary. This is to prevent some types of interference being fed from the equipment down into the mains supply, or in the other direction. Transformers are sometimes used for IMPEDANCE MATCHING.

BATTERY POWER SUPPLY:

A battery is a type of linear power supply that offers benefits that traditional line-operated power supplies lack: mobility, portability and reliability. A battery consists of multiple electrochemical cells connected to provide the voltage desired. Fig: 3.11 shows Hi-Watt 9V battery.

Fig. 16. Hi-Watt 9V Battery

The most commonly used dry-cell battery is the carbon-zinc dry cell battery. Dry-cell batteries are made by stacking a carbon plate, a layer of electrolyte paste, and a zinc plate alternately until the desired total voltage is achieved. The most common dry-cell batteries have one of the following voltages: 1.5, 3, 6, 9, 22.5, 45, and 90. During the discharge of a carbon-zinc battery, the zinc metal is converted to a zinc salt in the electrolyte, and magnesium dioxide is reduced at the carbon electrode. These actions establish a voltage of approximately 1.5 V.

The lead-acid storage battery may be used. This battery is rechargeable; it consists of lead and lead/dioxide electrodes which are immersed in sulfuric acid. When fully charged, this type of battery has a 2.06-2.14 V potential (A 12 volt car battery uses 6 cells in series). During discharge, the lead is converted to lead sulfate and the sulfuric acid is converted to water. When the battery is charging, the lead sulfate is converted back to lead and lead dioxide A nickel-cadmium battery has become more popular in recent years. This battery cell is completely sealed and rechargeable. The electrolyte is not involved in the electrode reaction, making the voltage constant over the span of the batteries long service life. During the charging process, nickel oxide is oxidized to its higher oxidation state and cadmium oxide is reduced. The nickel-cadmium batteries have many benefits. They can be stored both charged and uncharged. They have a long service life, high current availabilities, constant voltage, and the ability to be recharged.

RECTIFIERS

A rectifier is an electrical device that converts alternating current (AC) to direct current (DC), a process known as rectification. Rectifiers have many uses including as components of power supplies and as detectors of radio signals. Rectifiers may be made of solid-state diodes, vacuum tube diodes, mercury arc valves, and other components.

A device that it can perform the opposite function (converting DC to AC) is known as an inverter.

When only one diode is used to rectify AC (by blocking the negative or positive portion of the waveform), the difference between the term diode and the term rectifier is merely one of usage, i.e., the term rectifier describes a diode that is being used to convert AC to DC. Almost all rectifiers comprise a number of diodes in a specific arrangement for more efficiently converting AC to DC than is possible with only one diode. Before the development of silicon semiconductor rectifiers, vacuum tube diodes and copper (I) oxide or selenium rectifier stacks were used.

BRIDGE FULL WAVE RECTIFIER:

The Bridge rectifier circuit is shown in fig:3.8, which converts an ac voltage to dc voltage using both half cycles of the input ac voltage. The Bridge rectifier circuit is shown in the figure. The circuit has four diodes connected to form a bridge. The ac input voltage is applied to the diagonally opposite ends of the bridge. The load resistance is connected between the other two ends of the bridge.

For the positive half cycle of the input ac voltage, diodes D1 and D3 conduct, whereas diodes D2 and D4 remain in the OFF state. The conducting diodes will be in series with the load resistance R_L and hence the load current flows through R_L.

For the negative half cycle of the input ac voltage, diodes D2 and D4 conduct whereas, D1 and D3 remain OFF. The conducting diodes D2 and D4 will be in series with the load resistance R_L and hence the current flows through R_L in the same direction as in the previous half cycle. Thus a bi-directional wave is converted into a unidirectional wave.

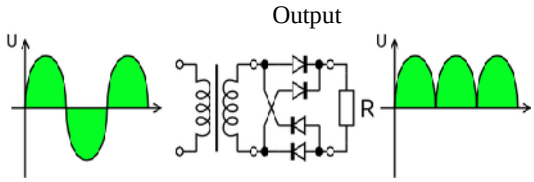


Fig. 17. Bridge rectifier: a full-wave rectifier using 4 diodes

DB107:

Now -a -days Bridge rectifier is available in IC with a number of DB107. In our project are using an IC in place of bridge rectifier. The picture of DB 107 is shown in fig:

Fig. 18. DB107

FEATURES:

- Good for automation insertion
- Surge overload rating - 30 amperes peak
- Ideal for printed circuit board
- Reliable low cost construction utilizing molded
- Glass passivated device
- Polarity symbols molded on body

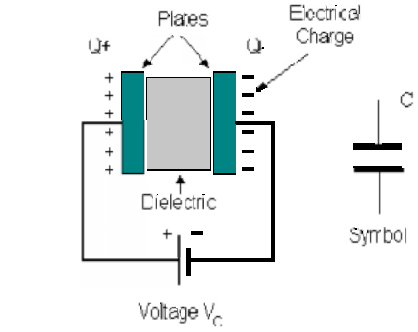
- Mounting position: Any
- Weight: 1.0 gram

FILTRATION:

The process of converting a pulsating direct current to a pure direct current using filters is called as filtration. Electronic filters are electronic circuits, which perform signal-processing functions, specifically to remove unwanted frequency components from the signal, to enhance wanted ones.

Introduction to Capacitors:

The Capacitor or sometimes referred to as a Condenser is a passive device, and one which stores energy in the form of an electrostatic field which produces a potential (static voltage) across its plates. In its basic form a capacitor consists of two parallel conductive plates that are not connected but are electrically separated either by air or by an insulating material called the Dielectric. When a voltage is applied to these plates, a current flows charging up the plates with electrons giving one plate a positive charge and the other plate an equal and opposite negative charge This flow of electrons to the plates is known as the Charging Current and continues to flow until the voltage across the plates (and hence the capacitor) is equal to the applied voltage Vcc. At this point the capacitor is said to be fully charged and this is illustrated below. The construction of capacitor and an electrolytic capacitor are shown in figures



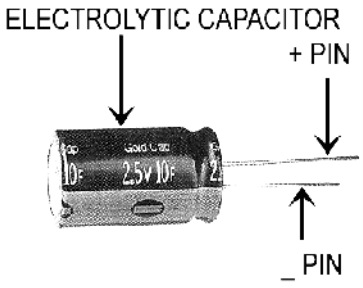


Fig. 19. Construction Of a Capacitor Electrolytic Capaticor

Units of Capacitance:

Microfarad (μF) 1μF = 1/1,000,000 = 0.000001 = 10^{-6} F

Nanofarad (nF) 1nF = 1/1,000,000,000 = 0.000000001 = 10^{-9} F

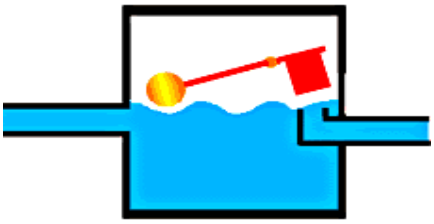
Pico farad (pF) 1pF = 1/1,000,000,000,000 = 0.000000000001 = 10^{-12} F

OPERATION OF CAPACITOR

Think of water flowing through a pipe. If we imagine a capacitor as being a storage tank with an inlet and an outlet pipe, it is possible to show approximately how an electronic capacitor works.

First, let's consider the case of a "coupling capacitor" where the capacitor is used to connect a signal from one part of a circuit to another but without allowing any direct current to flow.

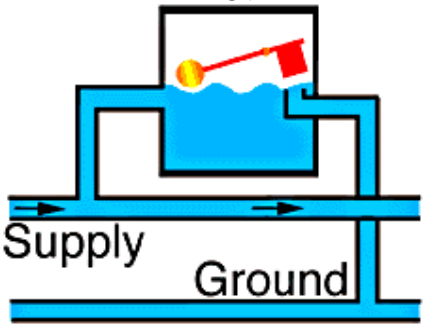
If the current flow is alternating between zero and a maximum, our "storage tank" capacitor will allow the current waves to pass through.



However, if there is a steady current, only the initial short burst will flow until the "floating ball valve" closes and stops further flow.

So a coupling capacitor allows "alternating current" to pass through because the ball valve doesn't get a chance to close as the waves go up and down. However, a steady current quickly fills the tank so that all flow stops.

A capacitor will pass alternating current but (apart from an initial surge) it will not pass d.c.



Where a capacitor is used to decouple a circuit, the effect is to "smooth out ripples". Any ripples, waves or pulses of current are passed to ground while d.c. Flows smoothly.

VOLTAGE REGULATOR

A voltage regulator (also called a 'regulator') with only three terminals appears to be a simple device, but it is in fact a very complex integrated circuit. It converts a varying input

voltage into a constant 'regulated' output voltage. Voltage Regulators are available in a variety of outputs like 5V, 6V, 9V, 12V and 15V. The LM78XX series of voltage regulators are designed for positive input. For applications requiring negative input, the LM79XX series is used. Using a pair of 'voltage-divider' resistors can increase the output voltage of a regulator circuit.

It is not possible to obtain a voltage lower than the stated rating. You cannot use a 12V regulator to make a 5V power supply. Voltage regulators are very robust. These can withstand over-current draw due to short circuits and also over-heating. In both caseregulator will cut off before any damage occurs.

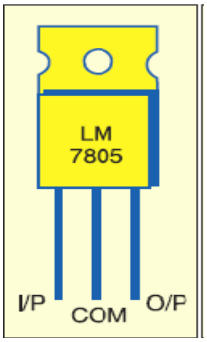


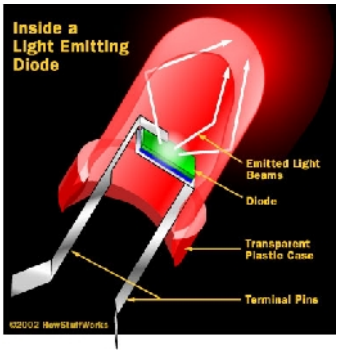
Fig. 20. Voltage Regulator

LED

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown in figures 3.15 and 3.16 respectively.

WORKING:

The structure of the LED light is completely different than that of the light bulb. Amazingly, the LED has a simple and strong structure. The light-emitting semiconductor material is what determines the LED's color. The LED is based on the semiconductor diode.



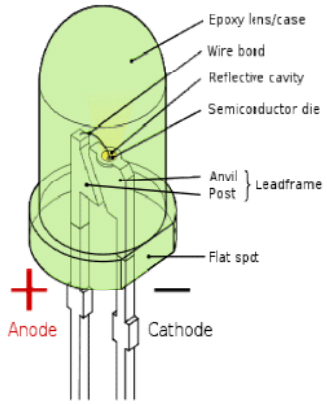


Fig 21. (i): Inside a LED
Fig. 21(ii): Parts of a LED

When a diode is forward biased (switched on), electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy gap of the semiconductor. An LED is usually small in area (less than 1 mm^2), and integrated optical components are used to shape its radiation pattern and assist in reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability. However, they are relatively expensive and require more precise current and heat management than traditional light sources. Current LED products for general lighting are more expensive to buy than fluorescent lamp sources of comparable output.They also enjoy use in applications as diverse as replacements for traditional light sources in automotive lighting (particularly indicators) and in traffic signals. The compact size of LEDs has allowed new text and video displays and sensors to be developed, while their high switching rates are useful in advanced communications technology. The electrical symbol and polarities of led are shown in fig: 3.17.

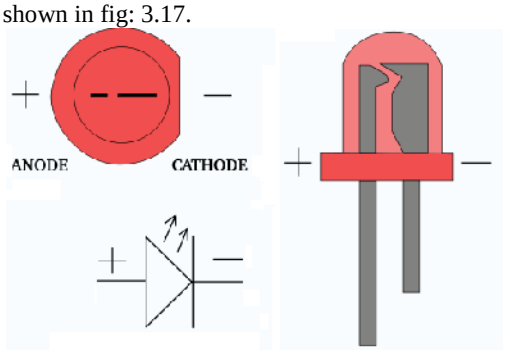


Fig. 22. Electrical Symbol & Polarities of LED

LED lights have a variety of advantages over other light sources:

- High-levels of brightness and intensity
- High-efficiency
- Low-voltage and current requirements
- Low radiated heat
- High reliability (resistant to shock and vibration)
- No UV Rays
- Long source life
- Can be easily controlled and programmed

Applications of LED fall into three major categories:

Visual signal application where the light goes more or less directly from the LED to the human eye, to convey a message or meaning.

Illumination where LED light is reflected from object to give visual response of these objects.

Generate light for measuring and interacting with processes that do not involve the human visual system.

ZIGBEE TECHNOLOGY:

INTRODUCTION:

When we hold the TV remote and wish to use it we have to necessarily point our control at the device. This one-way, line-of-sight, short-range communication uses infrared (IR) sensors to enable communication and control and it is possible to operate the TV remotely only with its control unit.

Add other home theatre modules, an air-conditioner and remotely enabled fans and lights to our room, and we become a juggler who has to handle not only these remotes, but also more numbers that will accompany other home appliances we are likely to use.

Some remotes do serve to control more than one device after 'memorizing' access codes, but this interoperability is restricted to LOS, that too only for a set of related equipment, like the different units of a home entertainment system Now picture a home with entertainment units, security systems including fire alarm, smoke detector and burglar alarm, air-conditioners and kitchen appliances all within whispering distance from each other and imagine a single unit that talks *with* all the devices, no longer depending on line-of-sight, and traffic no longer being one-way. This means that the devices and the control unit would all need a common standard to enable intelligible communication. ZigBee is such a standard for embedded application software and has been ratified in late 2004 under IEEE 802.15.4 Wireless Networking Standards.

ZigBee is an established set of specifications for wireless personal area networking (WPAN), i.e., digital radio connections between computers and related devices. This kind of network eliminates use of physical data buses like USB and Ethernet cables. The devices could include telephones, hand-held digital assistants, sensors and controls located within a few meters of each other.

ZigBee is one of the global standards of communication protocol formulated by the relevant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/ZigBee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Other standards like Blue tooth and IrDA address high data rate applications such as voice, video and LAN communications.

The ZigBee Alliance has been set up as "an association of companies working together to enable reliable, cost-effective, low-power, wirelessly networked, monitoring and control products based on an open global standard".

Once a manufacturer enrolls in this Alliance for a fee, he can have access to the standard and implement it in his products in the form of ZigBee chipsets that would be built into the end devices. Philips, Motorola, Intel, HP are all members of the Alliance. The goal is "to provide the consumer with ultimate flexibility, mobility, and ease of use by building wireless intelligence and capabilities into every day devices.

ZigBee technology will be embedded in a wide range of products and applications across consumer, commercial, industrial and government markets worldwide. For the first time, companies will have a standards-based wireless platform optimized for the unique needs of remote monitoring and control applications, including simplicity, reliability, low-cost and low-power".

The target networks encompass a wide range of devices with low data rates in the Industrial, Scientific and Medical (ISM) radio bands, with building-automation controls like intruder/fire alarms, thermostats and remote (wireless) switches, video/audio remote controls likely to be the most popular applications. So far sensor and control devices have been marketed as proprietary items for want of a standard. With acceptance and implementation of ZigBee, interoperability will be enabled in multi-purpose, self-organizing mesh networks

ARCHITECTURE:

Though WPAN implies a reach of only a few meters, 30 feet in the case of ZigBee, the network will have several layers, so designed as to enable interpersonal communication within the network, connection to a network of higher level and ultimately an uplink to the Web.

The ZigBee Standard has evolved standardized sets of solutions, called 'layers'. These layers facilitate the features that make ZigBee very attractive: low cost, easy implementation, reliable data transfer, short-range operations,

ZIGBEE CHARACTERISTICS

The focus of network applications under the IEEE 802.15.4 / ZigBee standard include the features of low power consumption, needed for only two major modes (Tx/Rx or Sleep), high density of nodes per network, low costs and simple implementation.

ZIGBEE APPLICATIONS

The Zigbee Alliance targets applications "across consumer, commercial, industrial and government markets worldwide".

Unwired applications are highly sought after in many networks that are characterized by numerous nodes consuming minimum power and enjoying long battery lives. Zigbee technology is designed to best suit these applications, for the reason that it enables reduced costs of development, very fast market adoption, and rapid ROI.Airbee Wireless Inc has tied up with Radio crafts AS to deliver "out-of-the-box" Zigbee-ready solutions, the former supplying the software and the latter making the module platforms. With even light controls and thermostat producers joining the Zigbee Alliance, the list is growing healthily and includes big OEM names like HP, Philips, Motorola and Intel.

With Zigbee designed to enable two-way communications, not only will the consumer be able to monitor and keep track of domestic utilities usage, but also feed it to a computer system for data analysis.

A recent analyst report issued by West Technology Research Solutions estimates that by the year 2008, "annual shipments for Zigbee chipsets into the home automation segment alone will exceed 339 million units," and will show up in "light switches, fire and smoke detectors, thermostats, appliances in the kitchen, video and audio remote controls, landscaping, and security systems."

D.C. MOTOR:

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The reverse process, producing electrical energy from mechanical energy, is accomplished by an alternator, generator or dynamo. Many types of electric motors can be run as generators, and vice versa.The input of a DC motor is current/voltage and its output is torque (speed).

The DC motor has two basic parts: the rotating part that is called the *armature* and the stationary part that includes coils of wire called the *field coils.* The stationary part is also called the *stator.* Figure shows a picture of a typical DC motor, Figure shows a picture of a DC armature, and Fig shows a picture of a typical stator.

Fig. 23. DC Motor

From the picture you can see the armature is made of coils of wire wrapped around the core, and the core has an extended shaft that rotates on bearings. You should also notice that the ends of each coil of wire on the armature are terminated at one end of the armature. The termination points are called the *commutator,* and this is where the brushes make electrical contact to bring electrical current from the stationary part to the rotating part of the machine.

OPERATION:

The DC motor you will find in modem industrial applications operates very similarly to the simple DC motor described earlier in this chapter. Figure 12-9 shows an electrical diagram of a simple DC motor. Notice that the DC voltage is applied directly to the field winding and the brushes. The armature and the field are both shown as a coil of wire. In later diagrams, a field resistor will be added in series with the field to control the motor speed.

When voltage is applied to the motor, current begins to flow through the field coil from the negative terminal to the positive terminal. This sets up a strong magnetic field in the field winding. Current also begins to flow through the brushes into a commutator segment and then through an armature coil. The current continues to flow through the coil back to the brush that is attached to other end of the coil and returns to the DC power source. The current flowing in the armature coil sets up a strong magnetic field in the armature.

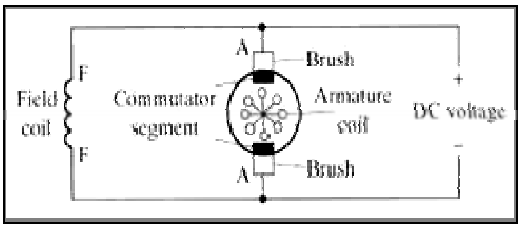


Fig. 24(i): Simple electrical diagram of DC motor.

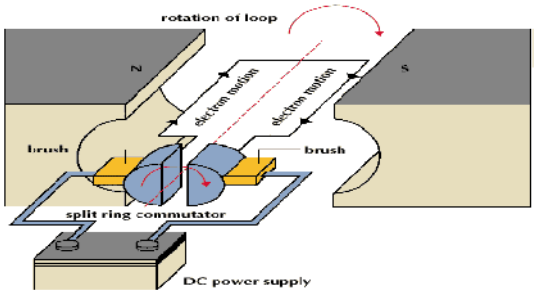


Fig. 25. (ii): Operation of a DC Motor

The magnetic field in the armature and field coil causes the armature to begin to rotate. This occurs by the unlike magnetic poles attracting each other and the like magnetic poles repelling each other. As the armature begins to rotate, the commutator segments will also begin to move under the brushes. As an individual commutator segment moves under the brush connected to positive voltage, it will become positive, and when it moves under a brush connected to negative voltage it will become negative. In this way, the commutator segments continually change polarity from positive to negative. Since the commutator segments are connected to the ends of the wires that make up the field winding in the armature, it causes the magnetic field in the armature to change polarity continually from North Pole to South Pole. The commutator segments and brushes are aligned in such a way that the switch in polarity of the armature coincides with the location of the armature's magnetic field and the field winding's magnetic field. The switching action is timed so that the armature will not lock up magnetically with the field. Instead the magnetic fields tend to build on each other and provide additional torque to keep the motor shaft rotating.

When the voltage is de-energized to the motor, the magnetic fields in the armature and the field winding will quickly diminish and the armature shaft's speed will begin to drop to zero. If voltage is applied to the motor again, the magnetic fields will strengthen and the armature will begin to rotate again.

WIRELESS A/V CAMERA:

(Model: SP-007AS)

A/V TRANSMITTER:

The camera is with 1.2GHZ, with Audio and CMOS and receiver unit with manual frequency adjustment. This wholesale product is already popular with China Tronic customers because of consistent high quality.

Fig. 26. Wireless A/V camera

- Linear Transmission Distance: 50-100m
- Transmission Signal: Audio, Video
- Receiving Signal: Audio, Video

3.9.2 TECHNICAL PARAMETERS OF TRANSMITTING UNIT:

1. Video Camera Parts: 1/3CMOS, 1/4 Image Sensors
2. System: PAL/CCIR NTSC/EIA
3. Effective Pixel: PAL: 628 x 582, NTSC: 510 x 492
4. Image Area: PAL: 5.78 x 4.19mm, NTSC: 4.69 x 3.45mm
5. Horizontal Definition: 380 Lines
6. Scanning Frequency: PAL/CCIR: 50Hz, NTSC/EIA: 60Hz
7. Minimum Illumination: 3 LUX
8. Sensitivity: +18DB-AGL On-Off
9. Electrical Level Output: 50mW
10. Frequency Output: 1.2Ghz
11. Transmission Signal: Audio, Video
12. Linear Transmission Distance: 50-100m
13. Voltage: DC+9V
14. Current: 300mA
15. Power Dissipation: 640mW

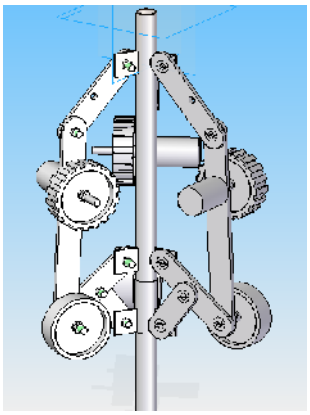
Fig. 27. Wireless camera

TECHNICAL PARAMETERS OF RECEIVING UNIT:

- Wireless Audio/Video Receiver
- Receiving Method: CPU Phase-Locked Loop Locking Frequency Points
- 4-Band Automatic Reception Switch
- Reception Sensitivity: +18dB
- Receiving Frequency: 1.2Ghz
- Receiving Signal: Audio, Video
- Voltage: DC+12V
- Current: 500mA

IV. . DESIGN METHODOLOGY

DESIGN OF ROBOT:



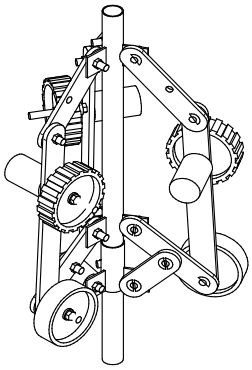


Fig. 27. (i):3D View of assembled robot
Fig. 27 (ii): 2D View of assembled robot

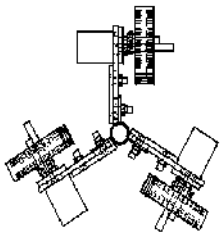


Fig. 27. (iii): **2D View of Top**

Separate parts of robot:

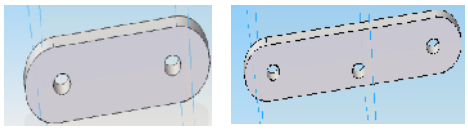


Fig. 28. (a): Three Links of Different Size (Aluminum metal)

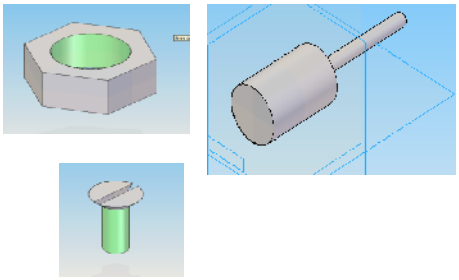


Fig. 28. (b)DC Motor Fig: 4.1.1(c) Screw Fig4.1.1(d)Nut

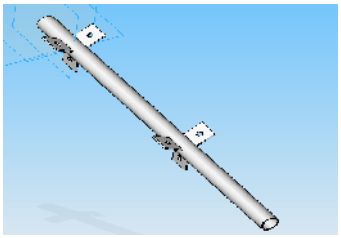


Fig: 28(e) Shaft (Mild Steel)

Wrist & End-effectors:

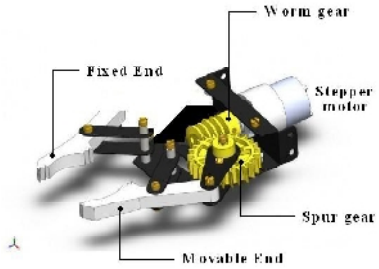


Fig. 29. Show of wrist & End-effectors

Description:-

- A spur gear meshing with a worm gear.
- 9 V stepper motor.
- Two end effectors out of which one is fixed and another is movable.

4.2.1. Design of Gripper Links:
The object to be lifted is: - Metal Plates
Weight of the object: - 50-80gm

The link has two parts, Part1 and Part2.
The Arm manipulator has length as follows:-
Part1 = 25 cm Part2 = 5 cm
Therefore, the ratio of the length of the two links is Link1: Link2: 5: 1

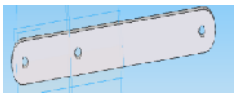


Fig: 29. (f) Supporting Wheel
Fig: 4.2(g) Gripper wheel

Arm-Manipulator:

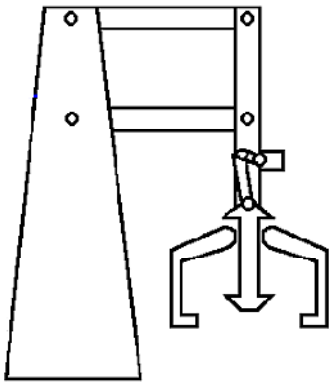


Fig. 30. View of arm manipulator

Description of arm manipulator

- Material:- Plastic
- Weight:- 30×2=60 gm for big arm

10×2=20 gm for small arm

- Length:- 25 cm for big arm

5cm for small arm

Motors (Stepper and AC motor):

Fig. 31. View of stepper motor
Description:-

- Step angle: - 1.8°
- Speed:-100 rpm
- Voltage:- 9 V
- Supply current: - 0.5 A DC
- Solder type: terminal

Spur Gear Arrangement:

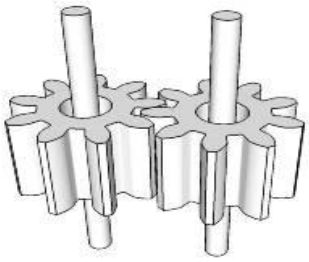


Fig. 32. View of spur gear arrangement

Description:-

- No of teeth on pinion=24
- No of teeth on gear=36
- Gear ratio= 36/24 =3/2
- Diameter of gear and pinion= 25mm and 15 mm
- respectively.
- Pressure angle= 20°
- Module=1.75 mm
- Pitch line velocity =πDpNp/60=(π*0.015*20)/60=0.01

Dimensions and Various Views :

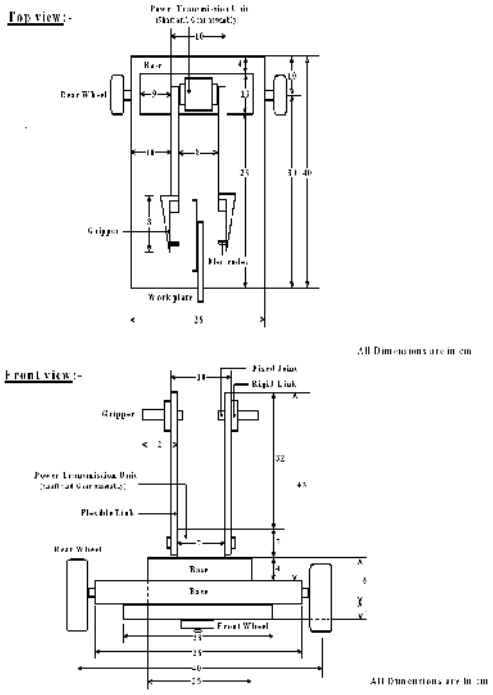


Fig. 33. Different views

DEGREES OF FREEDOM

In mechanics, the degree of freedom (DOF) of a mechanical system is the number of independent parameters that define its configuration. It is the number of parameters that determine the state of a physical system and is important to the analysis of systems of bodies in mechanical engineering,

aeronautical engineering, robotics, and structural engineering.

The position of a single car (engine) moving along a track has one degree of freedom, because the position of the car is defined by the distance along the track. A train of rigid cars connected by hinges to an engine still has only one degree of freedom because the positions of the cars behind the engine are constrained by the shape of the track.

An automobile with highly stiff suspension can be considered to be a rigid body traveling on a plane (a flat, two-dimensional space). This body has three independent degrees of freedom consisting of two components of translation and one angle of rotation. Skidding or drifting is a good example of an automobile's three independent degrees of freedom.

The position of a rigid body in space is defined by three components of translation and three components of rotation, which means that it has six degrees of freedom.

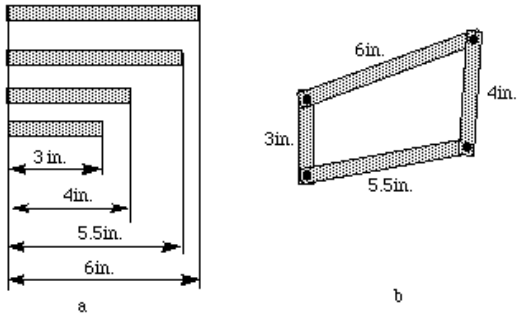
The Exact constraint mechanical design method manages the degrees of freedom to neither under constrain nor over constrain a device.

LINKAGE MECHANISMS:

Have you ever wondered what kind of mechanism causes the wind shield wiper on the front widow of car to oscillate

Let's make a simple mechanism with similar behavior. Take some cardboard and make four strips, Take 4 pins and assemble them

Now, hold the 6in. strip so it can't move and turn the 3in. strip. You will see that the 4in. strip oscillates



The four bar linkage is the simplest and often times, the most useful mechanism. As we mentioned before, a mechanism composed of rigid bodies and lower pairs is called a linkage(Hunt 78). In planar mechanisms, there are only two kinds of lower pairs --- revolute pairs and prismatic pairs.

The simplest closed-loop linkage is the four bar linkage which has four members, three moving links, one fixed link and four pin joints. A linkage that has at least one fixed link is a mechanism. The following example of a four bar linkage was created in SimDesign in simdesign/fourbar.sim.

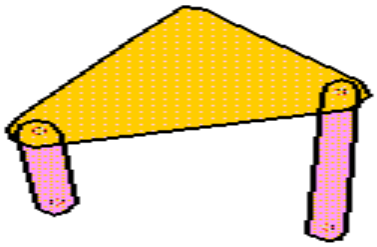


Fig. 34. SIM design

FOUR BAR LINKAGE IN SIMDESIGN:

This mechanism has three moving links. Two of the links are pinned to the frame which is not shown in this picture. In SimDesign, links can be nailed to the background thereby making them into the frame.

How many DOF does this mechanism have? If we want it to have just one, we can impose one constraint on the linkage and it will have a definite motion. The four bar linkage is the simplest and the most useful mechanism.

Reminder: A mechanism is composed of rigid bodies and lower pairs called linkages (Hunt 78). In planar mechanisms there are only two kinds of lower pairs: turning pairs and prismatic pairs.

Functions of Linkages

The function of a link mechanism is to produce rotating, oscillating, or reciprocating motion from the rotation of a crank or *vice versa* Stated more specifically linkages may be used to convert:

1. Continuous rotation into continuous rotation, with a constant or variable angular velocity ratio.
2. Continuous rotation into oscillation or reciprocation (or the reverse), with a constant or variable velocity ratio.
3. Oscillation into oscillation, or reciprocation into reciprocation, with a constant or variable velocity ratio.

Linkages have many different functions, which can be classified according on the primary goal of the mechanism:

- Function generation: the relative motion between the links connected to the frame,
- Path generation: the path of a tracer point, or
- Motion generation: the motion of the coupler link.

FOUR LINK MECHANISMS:

One of the simplest examples of a constrained linkage is the *four-link mechanism*. A variety of useful mechanisms can be formed from a four-link mechanism through slight variations, such as changing the character of the pairs, proportions of links, *etc*. Furthermore, many complex link mechanisms are combinations of two or more such mechanisms. The majority of four-link mechanisms fall into one of the following two classes:

the four-bar linkage mechanism, and The slider-crank mechanism. Some important concepts in link mechanisms are:

1. **Crank**: A side link which revolves relative to the frame is called a *crank*.
2. **Rocker**: Any link which does not revolve is called a *rocker*.
3. **Crank-rocker mechanism**: In a four bar linkage, if the shorter side link revolves and the other one rocks (*i.e.*, oscillates), it is called a *crank-rocker mechanism*.
4. **Double-crank mechanism**: In a four bar linkage, if both of the side links revolve, it is called a *double-crank mechanism*.
5. **Double-rocker mechanism**: In a four bar linkage, if both of the side links rock, it is called a *double-rocker mechanism*.

Circuit description:

In this chapter, schematic diagram and interfacing of PIC16F877A microcontroller with each module is considered**.**

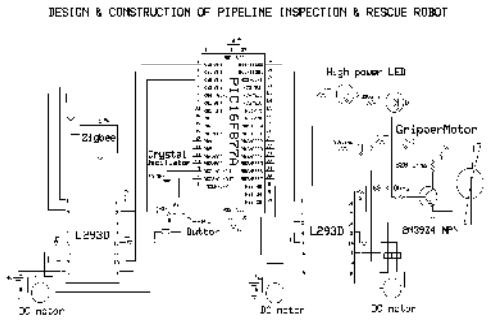


Fig. 35. Schematic diagram of receiver section of Design & Construction of Pipeline Inspection & Rescue Robot

The above schematic diagrams of Pipeline climbing Robot explain the interfacing section of each component with micro controller and personal computer. At the transmitting end Zigbee is connected to pc through RS 232 cable and DB9 serial pin connector and at the receiving end Zigbee another module connected to micro controller and crystal oscillator connected to 13th and 14th pins of micro controller and regulated power supply is also connected to micro controller and LED's also connected to micro controller through resistors and motor driver connected to micro controller The detailed explanation of each module interfacing with microcontroller is as follows:

INTERFACING CRYSTAL OSCILLATOR WITH MICRO CONTROLLER:

Fig 5.2: explains crystal oscillator and reset button which are connected to micro controller. The two pins of oscillator are connected to the 13th and 14th pins of micro controller; the purpose of external crystal oscillator is to speed up the execution part of instructions per cycle and here the crystal oscillator having 20 MHz frequency. The 1st pin of the microcontroller is referred as MCLR ie.., master clear pin or reset input pin is connected to reset button or power-on-reset.

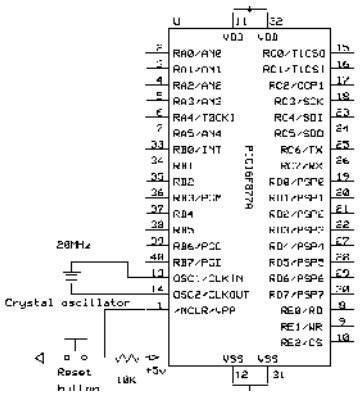


Fig. 36. Crystal oscillator interfacing with micro controller

V.FABRICATION OF ROBOT

5.1 MAIN BODY:

First did the marking on aluminum material as per design with the help of details obtained by drafting in Solid edge software. Facing & drilling and metal removing , finishing operations are done by use Slotting, Shaper , drilling and grinding machine to get the material of required dimension using machine tools of size thus unwanted material is removed.

VI. RESULT

6.1 The project "**DESIGN AND CONSTRUTION OF PIPELINE INSPECTION AND RESCUE ROBOT**" was designed to construct a Robot which is capable of climbing the pipeline. The robot was operated using computer wirelessly using zigbee from a remote location and also such that Robot can move either Forward by pressing button 'f' or Backward by pressing button 'b', from the PC through the Hyper Terminal. This robot has a high power LED which acts as a light source inside the pipe.

FUTURE SCOPE

In future we can use this project in several applications by adding additional components to this project. By connecting wireless camera to the robot, then we can see the outer world from our personal computer only by using GPRS and GPS. We can use this robot at so many fields and we can use to handle so many situations.

By connecting bomb detector to the robot, we can send it to anywhere i.e (battle field, forests, coal mines, to anyplace) by using our personal computer and we can able to detect the bomb at field, here sensor detects the bomb and gives information to micro controller and it gives the information to transceiver and it sends the information to the personal computer.

By connecting temperature sensor to the robot we can get the temperature of dangerous zones in personal computer itself instead of sending human to there and facing problems at field we can send robot to there and sensor will detect the temperature and it gives information to the micro controller and micro controller gives the information to the transceiver from that we can get the data at pc side.

By connecting smoke sensor to the robot we can get the information related concentration of smoke or gases in respective field's i.e. (coal mines, dangerous zones, etc). sensor sense the information and it give to the micro controller and it gives to the transceiver and from that we get the information in personal computer.

By connecting corresponding instruments to the robot we can use it in agriculture for farming purpose. This robot can move either forward and backward and left and right depend upon our instructions so we can do some part of agriculture from pc only by using robot.

By connecting firing instrument and wireless camera to the robot we can fire the target from pc. Here by using camera we can see the opposite target and we can fire the target from personal computer by pressing selected button and we can easily handle the situations like Mumbai terrorist's attack without loss of human life's and we can decrease our soldiers effort too.

ADVANTAGES & APPLICATIONS:

ADVANTAGES:

1. Controlling of Robot is done through PC using wireless Zigbee module.
2. Capable of rescuing a child in a borehole.
3. User friendly.
4. Low power consumption.
5. No need of training for the movement of robot
6. Wireless controlling of Robot through PC using Zigbee technology.
7. Live Audio and video can be seen on TV.
8. Implementation of pick and place concept to the robot.
9. DC motor based gripper operation for robotic arm.

APPLICATIONS:

1. The robot can be used for bore hole investigation
2. The robot can be used in military areas inside caves for investigation
3. The system can also in oil field industries to monitor the parameters inside the pipe lines
4. This system can also be used in under ground cable lines to check t he availability of obstacles inside the cable lines.

VII. CONCLUSION AND FUTURE SCOPE

Pipe penetration radar (PPR) is the underground in pipe application of ground penetrating radar (GPR) either robotically or by manned entry to reveal wall thickness, delimitation, voids, and other conditions that enable more precise determination of pipeline integrity and verifications for trenchless technology rehabilitation. PPR, when applied to pipe- bursting applications, can be used to detect metallic repair clamps and sleeves, rein forcing in concrete, thrust restraint and anchor blocks, and exterior slip lined host pipe casings. PPR also has the capabilities to conform the presence of grouting material between re rehabilitation liners and out pipe walls for ground stabilization and void elimination. PPR has the ability to identify lateral locations behind rigid liners for reinstatement and re connection. This technology significantly impacts sub surface infrastructure condition based asset management by providing previously unattainable measurable conditions.

Just as GPR has become a routine survey tool for the location of embedded elements such as rebar and post-tension cables in structural assessment for above ground concrete structures, PPR has the potential to achieve very similar status for underground non ferrous-pipes within the next few years. Advance in sensor technology, data interpretation via sophisticated software ever using increasing speed and processing power and acceptance by the engineering community will ensure that structural condition assessments using PPR will became more prevalent information and technology gapes identified by the USEPA in 2010 will rapidly be addressed to the benefit of owners of underground assets.

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