ASTrophysics

REMOTE CONTROL VIA CELLPHONE

STAIR CONQUEROR

THE AMPHIBIOUS ADVENTURE

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FracGEN

AMATEUR BAND TRANSMITTER

THE STYROFOAM PLANE

'Celebrating A Decade Of Excellence'

RC ORNITHOPTER

CELEBRATING A DECADE OF EXCELLENCE!
The pursuit of demystifying the mind boggling laws which make life and the world around us possible has been the most fascinating journey in the human history. Be it the discovery of fire, of agriculture, of electricity or be it the dream of flight or be it the revolutionizing development of quantum physics; every small bit of knowledge, every invention has played its own incredible role! We, The Science and Technology Council, carry forward the very same spirit in a quest for satisfying our intellectual curiosities. Factually, we are a consortium of 9 hobby clubs under the banner of the exemplary Student’s Gymkhana of IIT Kanpur!

For the uninitiated, we truly believe science to be as beautiful as a woman’s nightmare! Oh yes, we are a group of social geeks, the super-uber ones to be precise. This our calling to the masses - The Voice of the Geeks: ‘I think, I tinker, therefore I am’. With this we challenge every grey-cell in this universe to think, to imagine, to innovate, to create, to push the barriers of technology and carve the world of tomorrow. For giving you a head-start into the amazing world of technology, we thought of sharing some of the exciting work we did over the past year. What better a way to mark a decade of our existence!

We have essentially provided here a glimpse of some of our projects with the intent of introducing the reader to the concept of ‘Technology - A hobby, a way of life.’ We strongly believe that technology can be pursued as a hobby and when done so, it incarnates itself as a source of fun and pleasure. I would encourage the reader to give it a shot and get his/her hands dirty, for in no time he/she would realize that the flavour of such an endeavour is no different than any other form of art!

I hope this magazine acts as an instrument to inspire the genius and creativity in people not only in IIT Kanpur but across the nation. For students, this serves as an introduction to the endless world of possibilities which modern science enables. For educators, it serves as a window into the world of student-driven design and innovation. If the pages to follow leave you with more questions than answers, with a desire to create, I would say that the purpose of this piece of work is fulfilled.

In the end, I would like to acknowledge my whole team consisting of club coordinators, club secretaries, design executives, PR executives and sci-tech affair secretaries for their sustained efforts towards accomplishment of the council’s vision of which this work is a reflection. I would specially like to thank Bhuvnesh, Kapil, Puneet and all the authors for making this magazine possible. Hope you have a stimulating read!

Regards,

Pulkit Agrawal,
General Secretary,
Science and Technology Council,
IIT Kanpur
sntsecy@iitk.ac.in , pulkitagrawal.mail@gmail.com
From the Editor’s Desk

The idea of ‘out of sight, out of mind’ is a drive that leads us on wildest of the expeditions, to show off our expertise, to gain attention and what not! Science and Technology Council, IIT Kanpur has been doing some exemplary work over the past few years; the work which has never been brought out in the open before.

To encourage the future scientists, engineers and techno-entrepreneurs it is significant that their groundbreaking accomplishments be recognized in the budding stage itself. Not only do the contributors feel instigated, more importantly, it’s the spectators who are inspired to break the ground themselves. Therefore, for the first time ever, we bring you a delicious read highlighting the contributions of SnT Council to the scientific and engineering aura of the institute!

The council has been making its mark on the national level by bringing laurels in various national level technical festivals. Moreover, it makes a point of aligning its interests with those of the institute.

Last but not the least, the whole team of SnT Council should be congratulated for sustaining the initiative through the years in collaboration with the ever-contributing faculty of IIT Kanpur. Kudos to the efforts the team puts in every year to educate the new crop of students!

SnT Council really completes the 'T' in IIT Kanpur; I hope you feel the same too!

Regards,

Bhuvnesh Goyal
Astrophysics

What comes to your mind when you encounter words like Astronomy and Astrophysics?

Many people think that it is a useless activity where people waste their time just staring at the sky. Well, that’s not true. Astronomy is a detailed scientific study of objects and phenomena outside earth’s atmosphere, and as the name suggests astrophysics is branch of astronomy which deals with the physics of the universe, including the physical properties of the celestial objects. In this article we will discuss topics like importance and history of astrophysics, its application and fictitious astronomy.

Origin of astronomy coincides with the birth of human kind. Human has always been curious about the objects seen in the night sky. Although in ancient times, people were not interested in scientific studies but in the patterns observed in the sky, like repeating phases of moon, patterns in stars etc. As civilizations developed, most notably in Greece, Egypt, India and China, astronomical measurements were recorded and gave birth to astronomy. At the same time there were many religious beliefs which seemed illogical to modern sciences, such as earth being the centre of universe. Some intelligent minds like Kepler, Galileo, Newton and many other worldwide tried to prove them scientifically wrong, which gave rise to astrophysics.

After Newton discovered Universal law of Gravity, many events like eclipse, tides became predictable. Astrophysics played an important role in making people renounce their beliefs in religious myths. Many myths like comets being seen as a warning from heaven was proven wrong when Helly calculated its time period and predicted its next appearance. As sky is open to all, anybody can see observatory proof to verify those results.

Let’s move onto the applications of astrophysics, which are very important to mankind in this age. Whether it is sending a satellite to space or travelling far from earth to other celestial objects like Moon or Mars, they require use of physics at astronomical scale. Sending a probe to other planet includes control and tracking of all the series of events and very precise calculations (e.g. aiming accurately in that direction where the planet will be when the probe reaches its orbit). Use of modern computer and theories of astrophysics have assisted us hugely. Nowadays scientists can examine the chemical composition and physical properties of distant planets just by observing it from earth. This can help us to study nature of other planets and how will we be able to civilize human race on other planets.

Currently NASA is trying the same on Mars and who knows, in future we might able to set space colonies or cities on Mars.

Due to various restrictions, many experiments can’t be conducted on Earth; hence we conduct them in space. Space stations are conducting experiments as to study the effect of space on humans, which might help us to set up a complete space colony. One of the most vibrant applications of astrophysics can be ‘Time Travel’. Before stating anything, it is necessary to have a brief introduction to Theory of Relativity. One of the principles of relativity is that the faster you go the slower the time runs for you. Time is the 4th dimension of space. To understand it properly lets us take a model. Consider a trampoline. When a heavy ball is placed on it, it gets bend near the ball.
Now if you can see initially 2D trampoline was converted into 3D after it bends. Similarly space is twisted or bend if a heavy mass is placed in space and hence after the bend 3D space converts into 4D space (although the particles are restricted to 3D motion only). Also light always travel along the bend of space. These properties were proved by Albert Einstein in his famous papers in 1905 and 1915 namely special and general theory of relativity respectively. These have been experimentally proven when particle accelerator was increased, and when light was observed tracing the bent of space in a solar eclipse in 1919 according to Albert Einstein's theory. For this to have a noticeable effect we have to travel comparable to the speed of light. As discussed earlier, some experiments like this cannot be conducted on earth. Hence we think of conducting it in space. We can use the property which comes through the study of theory of relativity - when we move light in a circular path, it twists the surrounding space. Its counter argument is also true, i.e. if we twist the space similarly we can use it to gain speed close to that of light, just like when we rotate a cup of tea with spoon and then add a bean on it, it also starts moving along with it. Research is going on to convert this fiction into fact. But many scientists have already discarded this theory as, they say, absence of any space tourists proves that it cannot be possibly made.

May be in future we might be able to actually design one and use it to free ourselves beyond the boundaries of time.

I will end this article by the most trivial but so far unanswered question, “How did the universe begin?” After the discovery by Hubble that every galaxy in universe is going away from each other, we can say that the galaxies were once close to each other. Scientists say that initially the galaxies were so close that they formed a very dense hot ball of mass, and a sudden explosion caused the formation of the universe popularly known as ‘The Big Bang’. It can be proven that when universe expanded and cooled down after some time it radiated microwaves radiation according to its temperature, which can still be observed through microwave receiver. The theory goes on and says that though it cooled but the temperature was high enough to form new particles through fusion and the cloud of these particles formed stars, planet and everything finally formed galaxies and this whole universe.

Some don’t agree to this theory.

Astronomy has had impact on our lives since ancient times to help us understand nature in a logical way, but astronomy also promises to give us a beautiful future of fictitious world.

**About the author**

Akshat Singhal is a second year undergraduate in the Department of Mathematics and Statistics. He can be reached at akshats@iitk.ac.in. He is interested in astronomy and astrophysics related current affairs.
Stair Conqueror

Introduction
It is dominantly a mechanical project and designed in a manner that it remains balanced at each stage of operation.

Motivation
We wanted to make a non-conformal project that could help handicapped climb the stairs.

Current method and technology used
Broadly, it consists of the front part and the rear part. Both parts can move horizontally as well as vertically with respect to each other.
The process of climbing is as follows:
- The front part senses the stair which is to be climbed.
- Then the front part moves up with respect to the rear part up to the stair height.
- Then the rear part moves horizontally such that the rear part is on lower step and the front part is on the upper step.
- Then the rear part moves up till it levels with the front part. In this position the front part is on the upper step and the rear part is in the air.
- Now the front part moves forwards and as both parts are connected, rear part which was in the air comes onto the upper step with the front part. Now the bot is on the upper step.

The video of the process can be seen on the following link http://www.youtube.com/watch?v=g0ORZd1Ei5k

Components used:
- Toy motors (1000-1500RPM)
- High torque motor (30 RPM)
- Balsa ply
- Mica sheet
- Toy motors with gears

Problem faced in this project
Most of the problems focussed on the balancing part of the robot (as mentioned above):
- The first problem we faced was the mechanism of lifting the rear part. We thought of three processes and the third one came out to be the most convenient.
1. Rack and pinion system: This consisted of a rack and pinion for the lifting part. We didn't continue with this because it was not possible to arrange light weight rack and pinion system.
2. The pulley system: This consisted of two motors and a pulley. We had to drop this idea because this was making the bot really heavy.
3. The third mechanism consisted of a high torque motor which was attached to the front part as shown in the photo.
- Levelling of the front and rear part: A lot of balsa wood was used in fixing the motors in the front and the rear part. The matter of weight was also taken into account so it became difficult to fix motors.

Salient and innovative features
Unlike other robots we used balsa wood in place of aluminium rods to make it lightweight. The robot has a special design and is very light to make sure it remains balanced at each step. We have used a pulley system instead of rack and pinion to lift the rear part. We have used bottle caps as wheels to maintain the dimensions.

Conclusions
If one has good design, then he/she can do accomplish without very good and ample resources. For instance, we used balsa ply instead of costly plastic. Also we learned the use of gears in motors to reduce or increase the torque.

Advancements that can be done in the future
1. The lifting process has a bit of friction at present. It can be made smoother.
2. The bot can be made autonomous.

About the authors
Ajaypal Singh is a second year undergraduate in the department of Mechanical Engineering at IIT Kanpur. He can be reached at ajaypals@iitk.ac.in.
Nishant Kumar is a second year undergraduate in the Department of Chemical Engineering at IIT Kanpur. He can be reached at nishantk@iitk.ac.in.
Servo Control System & Robotic Arm Manipulator

Introduction to Robotic Arm
A robotic arm is a robot manipulator, usually programmable, with similar functions to a human arm. The links of such a manipulator are connected by joints allowing either rotational motion (such as in an articulated robot) or translational (linear) displacement.

The links of the manipulator can be considered to form a kinematic chain. The business end of the kinematic chain of the manipulator is called the end effector and it is analogous to the human hand. The end effector can be designed to perform any desired task such as welding, gripping, spinning etc., depending on the application.

For example, robot arms in automotive assembly lines perform a variety of tasks such as welding and rotation and placement of parts during assembly. The robot arms can be autonomous or controlled manually and can be used to perform a variety of tasks with great accuracy. The robotic arm can be fixed or mobile (i.e. wheeled) and can be designed for industrial or home applications.

Aim of the Project
The main aim of the project was to study the characteristics of servo motors and build a robotic arm that can imitate activities of a human hand or can be controlled with a joystick.

Introduction to Servo Motors
Most of the robot arms are built with Servo Motors. These little motors can position their output shaft to any position on command and hold on to that position. Most servos have motion extending to about 210 degrees and thankfully are very easy to control. All RC (remote controlled) servos have three connections: power (positive), power (ground or negative) and the controlling signal. The interesting part is the control signal. An RC servo motor doesn’t just run when you just give it power. It’s an intelligent device and you must tell it what you want it to do. You need a control signal that drives the servo. Control Signal can be generated manually or automatically.

Controlling a Servo Motor
Servos are controlled by sending them a pulse of variable width. The control wire is used to send this pulse. The parameters for this pulse are minimum pulse, maximum pulse and repetition rate. Given the rotation constraints of the servo, neutral is defined to be the position where the servo has exactly the same amount of potential rotation in the clockwise direction as it does in the counter clockwise direction. It is important to note that different servos will have different constraints on their rotation but they all have a neutral position, and that position is always around 1.5 milliseconds.

The angle is determined by the duration of a pulse that is applied to the control wire. This is called Pulse width Modulation. The servo expects to see a pulse every 20 ms. The length of the pulse will determine how far the motor turns. For example, a 1.5 ms pulse will make the motor turn to the 90 degree position (neutral position).

If an external force pushes against the servo while the servo is holding a position, the servo will resist from moving out of that position. The maximum amount of force the servo can resist is the torque rating of the servo. Servos will not hold their position forever though; the position pulse must be repeated to instruct the servo to stay in position.

When a pulse is sent to a servo that is less than 1.5 ms the servo rotates to a position and holds its output shaft some number of degrees counter-clockwise from the neutral point. When the pulse is wider than 1.5 ms the opposite occurs. The minimal time and the maximum width of pulse that will command the servo to turn to a valid position are functions of each servo. Different brands, and even different servos of the same brand, will have different maximum and minimums. Generally the minimum pulse will be about 1 ms wide and the maximum pulse will be 2 ms wide.

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about 1 ms wide and the maximum pulse will be 2 ms wide.

**Generating servo Control Signal**
- There are many ways to generate control signal depending upon task. For this project we used simple timer ICs. 555 is an IC used to generate a clock. There are two modes in which 555 can run.

![Behaviour of a Standard Servo](http://students.iitk.ac.in/projects/_detail/servo_positioning.png?id=roboticsclub_roboarm)

- Monostable Mode
- Astable Mode

**Monostable mode**
As the name suggests; in this mode the output is stable in only one (mono) state i.e. 'off' state. Thus it can stay only for a finite time, if triggered, to the other state i.e. 'on' state. This time can be set choosing appropriate values of resistances in the formula:

\[
T = 1.1 \times R1 \times C1
\]

**Astable mode**
In this mode; the output is stable neither in 'high' state nor in 'low' state. Hence it oscillates from one state to another giving us a square wave or clock. We can set the clock frequency and Duty cycle D by the formula:

\[
F = \frac{1.44}{(R1+2R2) C1}
\]

\[
D = \frac{(R1+R2)}{(R1+2R2)}
\]

*output of astable timer was given into PIN2 of monostable timer.

Now all we need to do is to generate a square pulse at ~50 Hz frequency with adjustable duty cycle. For this we set up a 555 timer in astable mode that generated clock pulse at ~50 Hz frequency. With that square pulse another 555 timer (monostable mode) was triggered.

On every rising/falling edge of output from astable timer, monostable timer is generating a square pulse with pulse width \( T = 1.1 \times R1 \times C1 \). Now we can modulate Pulse Width using variable R1 and C1. PIN 3 of monostable timer is generating required Servo Control Signal. Now we are ready to control servo motor with potentiometer (R1).

**Advantage of Servo**
Their main advantage over traditional DC or AC motors is the addition of motor feedback. This feedback can be used to detect unwanted motion, or to ensure the accuracy of the commanded motion. We can attain precise control of position, velocity, and torque using servos.

**Applications**
Servo-mechanisms were first used in military fire-control and marine navigation equipment. Today servo-mechanisms are used in automatic machine tools, satellite-tracking antennas, remote controlled airplanes, automatic navigation systems on boats and planes and antiaircraft-gun control systems. Other examples are fly-by-wire systems in aircraft which use servos to actuate the aircraft’s control surfaces and radio-controlled models which use RC servos for the same purpose. Many autofocus cameras also use a servo-mechanism to accurately move the lens, and thus adjust the focus. A modern hard disk drive has a magnetic servo system with sub-micrometre positioning accuracy.

Another device commonly referred to as a servo is used in automobiles to amplify the steering or braking force applied by the driver. However, these devices are not true servos, but rather mechanical amplifiers (Power steering or Vacuum servo). In industrial machines, servos are used to perform complex motion.

**Team Members**
Ayush Goel (ayushg@iitk.ac.in)
Vineet Hingorani (viner@iitk.ac.in)
Vipul Choudhary (vipulch@iitk.ac.in)

**About the Author**
Vipul Choudhary is an undergraduate in the Department of Electrical Engineering at IIT Kanpur. He can be reached at vipulch@iitk.ac.in. His interests lie in Embedded Systems, Automation and Control of Electromechanical systems and Development of Service Robots.
Introduction
This robot was built in the summers of 2010. It solves a 5x5 mine using image processing, identifying different numbers with different colours. It was built primarily for Corsies competition of IIT Guwahati-Techniche.

Problem Statement
We started our project by choosing a problem statement of a Robotics Competition at the annual technical festival of IIT Guwahati-TECHNICHE’10.
Our aim was to make a completely autonomous robot which could navigate its way and identify different colours through image processing using images from an overhead camera, processed in a computer using MATLAB. The two main tasks that we were required to perform through this were:

1. First Stage (MAZE): Starting from a given black spot, the robot had to reach the other black spot in the white arena, avoiding the areas marked by red colour. This was just like solving a maze.

2. Stage (MINESWEEPER): In this round we had to solve a 5x5 minesweeper game in which different numbers were indicated by a colour coding:
   - Black- 0
   - Blue- 1
   - Green- 2
   - Red- 3
   - White - unopened block

The bot had to glow a yellow LED to open and red LED to flag the block, once it reaches on top of the particular block.
Initially the arena had to be mainly white, with one or two black boxes indicating zero. In a minesweeper, the number shown by the box indicates the number of mines around it. Our task is to identify the mines by opening the mines around it but without opening the mine itself.

The bot is shown by two yellow rectangles. The other colours were placed just for testing before the actual run.

Components required
1. Microcontroller – one Atmega 16
2. 1 L293
3. 1 LCD
4. 2 motors (100 rpm each)
5. 1 Serial Programmer
6. Connectors and wires.
7. 2 LEDs - one red and other yellow

Main steps
Programming part
1. Target reaching: The first main target was to make a robot reach a given spot through image processing.
   - We placed two rectangular strips of same colour but different area, bigger one on the back side and smaller one on the front side of the roof of the robot.
   - We detected the centroids of largest and second largest area of that colour by forming a binary image (image in which one particular is shown white and rest all black) of the image taken which gave us the centroids of the back and front of the robot. The vector formed by the (front centroid – back centroid) gave us the orientation vector of our robot.
   - Similarly, we detected the target which used to be of a different colour by making a binary image for the target colour and by finding its
• centroid.
• The required correct direction was supposed to be the vector obtained by subtracting the centroid of the roof-back from the target centroid.
• The angle between the robot’s orientation vector and the required direction vector was calculated.

Based on the angle a right or left turn was taken. Whenever the angle exceeded 90 degrees or was less than -90 degrees, the robot was moved back and if the angle was between -7 and 7 degrees (tolerance of 7 degree), the robot was moved forward.

The video of the completion of this task can be found here
http://www.youtube.com/watch?v=D8T6N_l2Cqs

2. Finding the shortest path covering two situations: For both the cases we used similar recursive algorithms (given below), employing dynamic programming.

a) Situation 1 for the MAZE Round: Given a starting and an ending block, find the shortest path avoiding given particular blocks:

For this we used the following algorithm.

• We divided the whole arena into a grid of square blocks such that the grid has m rows and n columns, where m and n could be decided by simulation to yield the best results.
• We marked the blocks to be avoided as zero, the blocks that can be used in path as one and the blocks that had already been traversed as two.
• We kept on storing the path having the least number of blocks covered till now in an array P1 by storing the indices of the blocks in that path. This array had been initialised to have a very high total blocks count so that the first valid path found automatically replaces this.

• Now the program looks for a valid block (block having number one or two) around it, out of the 4 blocks around it in 4 basic directions, and the advancement in any direction is stored by storing the index of the next block covered in an array P2. P2 initially has the starting block as its first entry and then subsequent blocks being traversed in a single possible path are stored in it.

• On finding a block having number 2, we look for the indices of the block in the array P1, because if this block is a part of the best path found till now, it must be in the array P1. If it is not found in P1, this advancement is rejected. In case, it is found in the array P1, then the number of blocks till now in P2 is compared with the number of blocks in P1 before the block. If the number of blocks in P2 is higher, this path is rejected. Else if the number of blocks in P1 is more, the initial portion of the path P1 till the current block having number two is replaced by the path P2.
• On finding a block with number one, it is replaced with number two, and the same function is called again, treating this as the current block, unless the found block is the target block.

b) Situation 2 for the Minesweeper round: Given a starting point and a number of points to be covered, find the shortest path: For this, we put the blocks to be covered in an array and used the following algorithm.

• In a loop from 1 to n, where n is the number of blocks to be covered, we chose one block each time to be the first one to be covered, calculated the distance from the starting block to that block, added it to a distance variable for a particular path, put the rest of the blocks in another array and called the same function with this array as an argument this time.

• This way the distance for the best path and the best path found till then were stored in separate variables and each time a path was completed, its distance was compared to the best till then, and the better one was stored. This way in the end we had the shortest path available.
• We realized that this algorithm could be improved to attain less time and space complexity but since the number of points was always going to be quite less, (25 in the worst case) in a 5x5 arena, we didn’t care much for the time and space complexities in this case, which eased the coding.

2. **Solving the minesweeper**: This was the most interesting step. Though we were assured by the organisers of the competition that we will be given minesweeper game with the difficulty level of a beginner, which uses the most basic algorithm, we explored and covered even the toughest challenge a minesweeper game can possibly offer, but only as far as no guesswork is not involved. It is not practically possible to cover all the algorithms devised and used by us (which makes more than 450 lines of MATLAB coding) in this much space. However, I will soon upload all the MATLAB codes on my homepage:
   
   http://home.itk.ac.in/~ankitbhu

   for motor driving, and LED for glowing. We converted our C program into a .hex file for the microcontroller using the software AVR Studio.

**Construction of the robot**

We had to constraint the robot in the 30x30 blocks completely before giving the signal for opening of any block (yellow LED) or detection of any mine (red LED). So we had to restrict the dimensions of the robot to 22x24, keeping in mind the involved error in image detection. We had a castor wheel in front and two motors with wheels on the rear side. On top of the robot we mounted the development board as well as the L293 circuit board. Then we had the roof on which we stuck two strips of the same colour but different areas, the larger one on the rear side and the smaller one on the front side. This was the construction part of our Robot.

**Electronics**

The controlling of robot was done using a microcontroller. ATMEGA 16 was chosen as it had all the required functionalities. A development board was made for the MCU. A serial programmer for the microcontroller was made. For controlling the motors, an L293 circuit board was made by us. Two 100 rpm motors were attached. We used UART communication through a USB to serial converter to send signals from the PC to the microcontroller.

**Problems faced during the project**

There were two main problems faced by us:

1. **Reading the colours**: Reading the colours properly created a big problem because we had 7 different colours to tackle with, in
different parts of the arena and due to non-uniform lighting, different colours gave strikingly different RGB values (Red, Green and Blue), an additive colour model in which red, green and blue light are added together in various ways to reproduce a broad array of colors. Also, during the competition, the organisers used bulb lights to show different colours which worsened the problem and was probably the main reason for us standing third in the competition and not first. What we learnt from the teams coming first and second was that they were using HSV (Hue, Saturation, and Value), a cylindrical-coordinate representations of points in an RGB color model, instead of RGB, which made colour detection easier.

2. The electronic circuitry: Another big problem was the frequent failing of the electronic components due to lose connections, but gradually we were finally able to make tight connections and trustable circuits.

Apart from this there were minor problems which I don’t think need a mention.

TEAM MEMBERS
- Ankit Bhutani
- Pranay Agrawal
- Jaskanwal Preet Singh Chhabra (jchhabra@iitk.ac.in)
- Amol Ratan Singh (arsingh@iitk.ac.in)

REFERENCES
We learnt image processing through a tutorial on image processing in MATLAB by Ankur Agrawal, ex-coordinator of the Robotics club, IIT Kapur. It is available for download here.
http://students.iitk.ac.in/roboclub/tutorials/Elementary%20Introduction%20to%20Image%20Processing%20Based%20Robots.pdf

This project could not have taken shape without the able guidance of Suhas Banshiwala, the present coordinator of the Robotics Club, IIT Kanpur. Some other useful information, regarding the electronic circuitry mainly, was always available on the Robotics club website.
http://students.iitk.ac.in/roboclub

TASK COMPLETION VIDEOS
The video for the target reaching part can be viewed from here:
http://www.youtube.com/watch?v=D8T6N_L2Cqs
The video for minesweeper solving can be seen here:
http://www.youtube.com/watch?v=s2fXhs4Jlpc

About the authors
Ankit Bhutani is a second year undergraduate in the Department of Electrical Engineering. He can be reached at ankitbhu@iitk.ac.in. His interests lie in robotics vision and artificial intelligence.
Pranay Agrawal is a second year undergraduate in the Department of Mechanical Engineering. He can be reached at pranagi@iitk.ac.in. His interests lie in robotics & automation, automobiles and applied mechanics.
Remote Control via Cell Phone
Use of DTMF Tones to send signals

Introduction
In this developing world, the need for remote control is quite significant. The distances involved may span from few meters to overseas. For this, the transmission of signal from remote to the device to be controlled can be carried out through various modes like internet, Bluetooth and GSM (global service for mobile) network. Internet requires a GPRS (General Packet Radio Service) enabled cell phone or computer and internet is not so easily available especially while travelling. Bluetooth with its limited range of few meters is not so useful.

The project aims at making a system capable of controlling remote system (in this case a mechanical system capable of performing few tasks) with a cell phone by decoding DTMF signals received at other end.

What’s DTMF?
DTMF is a multi frequency tone dialing system used by the push button keypads in telephone and mobile sets to convey the number or key dialed by the caller. DTMF has enabled the long distance signaling of dialed numbers in voice frequency range over telephone lines. DTMF (Dual tone multiple frequency) as the name suggests uses a combination of two sine wave tones to represent a key. So that a voice can’t imitate the tones, one tone is generated from a high-frequency group (column frequencies) of tones and the other from a low frequency group (row frequencies).

DTMF tones are thus mainly used at the telephone switching centers for detection of dialed-called number. They are also used by certain radio and cable TV networks. These networks use DTMF tones to signal a network station or local cable operator when a local advertisement is to be inserted or for station identification.

In layman’s terms, DTMF signal is the signal (voice) that is heard on pressing any numerical key when the call is on. Call you friend and say him to press any key on his phone. The voice heard on your side is DTMF signal.

Idea of the project
Idea of the project was to make use of these DTMF signals to control remote device. Once successful call is made from cell phone (used as remote) to the cell phone attached to device to be controlled, signals are sent to device when any numerical key is pressed on remote cell phone. The device on other side decodes the DTMF signals received and interprets the signal to behave accordingly. For this purpose any phone can be used as remote.

Work done during the project
For Nokia mobile (tested for Nokia 1202), keypad tones (turn them on to a loudness level easily audible) for numerical keys (0,*,#,9) are same as DTMF tones. The select key, cancel key or any additional keys present on cell phone don’t have any DTMF tone. A mobile other than Nokia may or may not have keypad tones same as DTMF tones.

To retrieve the DTMF signal from cell phone on the receiver's end, earphone jack was used. Different cell phones may have different type of earphone jacks and different pin out diagram. In the project, 3.5mm jack (compatible with most Nokia phones) was made use of.

We used software DTMF Decoder that

<table>
<thead>
<tr>
<th>1209 Hz</th>
<th>1336 Hz</th>
<th>1477 Hz</th>
<th>1633 Hz</th>
</tr>
</thead>
<tbody>
<tr>
<td>697 Hz</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>770 Hz</td>
<td>8</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>852 Hz</td>
<td>*</td>
<td>#</td>
<td>D</td>
</tr>
</tbody>
</table>

Corresponding frequencies for each key (keys A, B, C, D are not found on most cell phones)

General Pinout diagram for 3.5 mm jack
took input as DTMF signal through microphone (line
in or array) and outputs the corresponding key to the
screen after decoding it. This software helped in
understanding the concepts.
CM8870/70C decoder IC takes DTMF signal as input
and gives 4-bit output representing corresponding
key. It uses band pass filters and digital counting
techniques for
the detection and decoding
of all sixteen
DTMF tone
pairs (though
we require
only twelve i.e.
1,2,...,9,0,*,#)
into a 4-bit
code which
can be send to
microcontroller
for further
analysis. On
the basis of
input received
by MCU, it sends signals to the actuators.

After initial prototyping of the circuit on
breadboard, final circuit was soldered for making
final system.

Project Completion
The project ended with making of a mechanical
system capable of being controlled by any cell phone
from all over the world. Mechanical system inspired
from fire brigade vehicle consisted of ladder capable
of rising and increasing length. The mechanical
system could make translational movements as well.
The user had to call a particular number (number of
cell phone attached to mechanical system) and then
user could control the device by pressing
appropriate numerical buttons (as programmed in
the microcontroller).
The project video can be downloaded from Robotics
Club channel at youtube.com/roboclub

Conclusion
Most DTMF decoders can process at least 10 tones
per second under the worst of conditions, so DTMF
can easily convey 40 (10 x 4) bits or 5 bytes of data
per second which is nowhere near to the
performance of a good communication modem but
with most of the world supporting wireless cellular
network (GSM or UTMS) and its vast coverage area
makes it ideal for signal communication from remote
to device. Though the communication is paid but
ever decreasing call costs make it suitable. Also just
any cell phone can act as remote without any
modification or need of external device. Just
subscription to cellular service provider is required.
The system can largely control any type of device
(except where high speed communication is
required). The concept of smart house is proposed
which has the capabilities of
switching off
lights, locking
the door, etc. all being
controlled just
by cell phone if
person has
unintentionally
forgotten to do
so in a hurry.

Future scope
The system can
be made more
interactive by
setting an automatic voice message generator on the
device to be controlled for providing instructions or
acknowledging the signals sent.

Acknowledgements
Thanks to enthusiastic Robotics Community in the
campus for their help and able guidance time to time.
The work of SnT Council for publishing this article is
too acknowledged.

Resources
1. 4i Labs, IIT Kanpur for making of gears for mechanical system.
2. Read about DTMF:
   http://www.genave.com/dtmf.htm,
   http://www.engineersgarage.com/tutorial/
   s/dtmf-dual-tone-multiple-frequency
3. 8870 Datasheet:
   http://www.datasheetcatalog.org/datasheet/
calmicro/CM8870.pdf

Team for project
Romil Gadia (romilg@iitk.ac.in)
Pankaj Jindal (pankajj@iitk.ac.in)
Nehchal Jindal (nehchal@iitk.ac.in)

About the author
Nehchal Jindal is second year undergraduate in the
Department of Computer Science and Engineering at
IIT Kanpur. He can be reached at nehchal@iitk.ac.in.
His interests lie in Robotics and Artificial
Intelligence.
A 12 Volts, 1500 rpm DC motor was fitted on a heavy wooden plank. Power to atmega was given by two slip rings, one attached to the motor shaft and another to the metal structure. Both the parts (DC motor and strip) were joined together with the help of a collar on the shaft of the motor.

For displaying any image or text the whole image is divided into different rectangular sections. The table formed may contain maximum of 30 rows (number of LEDs used) and number of columns may be adjusted according to the resolution required. As we were using the concept of interrupts, its total
resolution could be varied to a large extent. We divided the world map into 30 rows*75 columns for our project. Once the map was divided into different sections, we wrote the binary equivalent for each row - 1 for ON and 0 for OFF. Corresponding values for all columns were stored in arrays for different ports of atmega. We however, converted those binary equivalents into corresponding decimal values for reducing the size of program.

**Sectioning of Map**
The whole world map was sectioned into a table of thirty rows and seventy-five columns. The binary equivalent for each column was written. For instance, the binary equivalent of 1st column was:

- 00001000 (PORT A)
- 00000000 (PORT B)
- 00000000 (PORT C)
- 00000011 (PORT D)

Software incorporated use of two interrupts: one external and another internal. External interrupt triggered the start of the internal interrupt and also kept a note of the time between two consecutive external interrupts, which actually was the time period of our motor (time period was not constant, it depended on air resistance).

Internal interrupt was for changing the mode of LED's according to what we wanted to display. We worked with a resolution of 75*30, thus the frequency of the internal interrupt was set to occur 75 times before another external interrupt occurred via TSOP sensor on each rotation.

**CIRCUIT**
The TSOP circuit source, developed by the Electronics Club, IITK, is shown in the diagram below:

![TSOP circuit source: E-Club](http://easyelectronics.ru/3d-led-globus.html)

**Applications**
Since this display can produce a spherical screen over which any image or text can be displayed at any resolution, it can be used in advertising and marketing industries.

**Future scope**
1. Size of LEDs can be reduced to produce a higher resolution display.
2. We can replace TSOP by a magnetic sensor for more accurate reading of external interrupt.
3. Dual coloured LEDs can be used for representing different area with different colour. For instance, in case of this globe we could represent land and water with different colours.
4. More stable hardware design may be implemented to reduce the wobbling of the whole system. The hardware design should be such that its centre of mass lies on the axis of the globe.

**Acknowledgement**
We give our sincere thanks to our project mentor Joy Bhattacharjee and Electronic -Club coordinators for the successful completion of the project. We would also like to thank lab assistants of Mechanical and Material Sciences labs for helping in the hardware aspect.

For further information on this display type you can have a look at:
http://hackaday.com/2010/05/19/32-led-pov-globe/

You can watch the video of our project at:
http://www.youtube.com/watch?v=NEAE5czgxlI

**About the author**
Amit Barjatya is a second year undergraduate student in the Department of Electrical Engineering at IIT Kanpur. He can be reached at amitbarj@iitk.ac.in. He is deeply interested in core Electronics and wishes to make a future in VLSI designs. In his leisure time, he enjoys listening to soft music and reading articles on recent technology.
Enron’s collapse, Sub-prime Crisis, Lehman Brothers’ bankruptcy, Sovereign Debt crisis, etc you name it and there is an endless list of financial slumps either due to unethical policies and practices or due to traceable loopholes in the risk management policies of various financial institutions. A study of past events in the global financial world with reference to the various kinds of crisis that have rocked the global economy, urged us to take up a project on RISK MANAGEMENT IN FINANCIAL INSTITUTIONS under the Business Club in IIT Kanpur, and study the basic processes that help any institution secure its financial status and avoid any probability of unwanted losses.

- Risk Management in corporate sector is essentially the process to deal with the uncertainties resulting from financial markets. Organizations manage financial risk using a variety of strategies and products with reference to internal business policies. The initial part of the project included a broad study of the financial risk management policies and their implementation in the real world with reference to the various categories of risk namely Credit, Market and Liquidity Risk. The basic processes involved in Risk Management are:-
  
  - Identify key financial risks: A financial institution is prone to various types of risks like credit risk, market risk, liquidity risk, operational risk, reputational risk. So, it has to first select the important risks which can cause more harm to institution’s financial health.
  
  - Determine an appropriate level of tolerance: It is not desirable or possible to eliminate risk. In this competitive market, everyone has to take risk. So, each institution has to determine an appropriate level of risk tolerance.
  
  - Implementation of Policies: Each institution makes its own policies to mitigate risk like hedging using futures, diversification.
  
  - Measure, Report and Refine: Each institution has to continuously measure the amount of risk. On the basis of it makes report and based on report, they have to refine the policies if needed.

Due to vast expanse of the global financial arena, it was decided to zoom in on Commodity Risk, a kind less heard but of great importance, for detailed study. Commodity risk refers to the tumult in future market values and in the size of the future income, caused by the fluctuation in the prices of commodities. These commodities may be grains, metals, gas, electricity etc. The project work included and extensive study of how FUTURES are used to hedge against price volatility risks while trading commodities. A Futures contract is a standardized contract between two parties to buy or sell a specified asset (e.g. oranges, oil, gold) of standardized quantity and quality at a specified future date at a price agreed today (the futures price). The contracts are traded on a futures exchange. The recent oil spill in the Gulf of Mexico, speculation in the trend of oil prices after peaking of oil production in 2008, etc were certain motivating factors for choosing crude oil for practical analysis. There was an extensive study of the trends in the global pricing of crude oil in the past three decades. In this context focus was also given to important turnovers in the history of global economy such as Oil Shock (1970), Oil crisis (1973), Oil glut (1980-85), Global Recession (2008).

Moving onto the practical work in the project we underwent a study on how TECHNICAL ANALYSIS is used to measure and analyse future trends in commodity prices. A report was presented on what could be the possible future trends based on historical prices and volumes sold using various Technical Indicators. However there were certain limitations on this analysis, as daily data was almost unavailable and hard to procure and our study was based on the monthly average crude oil Future Prices. The conclusion regarding the trends can be used in trading derivatives and speculating future prices. However it is to be kept in mind that before making any decision, it is important to weigh the predicted trends against the existing market trends and then exercise one’s discretion because TECHNICAL ANALYSIS is completely market independent.

The project work helped us understand the subtle details about the working of financial institutions like Investment Banks, Mutual Funds, etc. Also we received an insight into the working of the crude oil sector and the global and domestic pricing patterns of oil and its after products.

Author
Ankur Agrawal
GizmoNav
GPS Microcontroller based Navigation Device

Introduction
A GPS tracking unit is a device that uses the Navstar Global Positioning System to determine the precise location of a vehicle, person, or other asset to which it is attached to and to record the position of the asset at regular intervals.

Motivation
Establishing wireless communication over long distances but precisely locating the location challenged us. Our first plan was to make the tracking unit but we had to drop it due to the time constraints. The project objective was to make a device which can display the user’s present location on a digital map and show the shortest path to any specified location.

Current Techniques in Use
Many latest cell phones use SiRFstarIV based GPS microcontroller chips. We used a SiRFstarIII based chipset module.

Ideas/Research Work
- After a lot of research on the technical details of GPS receivers we chalked out the basic building units (filters, low noise amplifiers, frequency synthesizers and ADC’s) on a PSoC (Programmable System on Chip). Receiver sensitivity is the minimum amount of RF intensity required to detect by the receiver. The problem with PSoC is it has low RF sensitivity.
- We used greedy algorithm for finding the shortest path. It works fine due to the pattern in which roads are constructed.
- We implemented wire frame model for displaying 3D structures individually. The final project didn’t have this due to memory constraints.

Experimental Design Used
The following experimental design was used during the course of the project of making a GPS Microcontroller based Navigation Device:
The device is built on a 8 bit microcontroller. We established UART communication using self written code with the gps chipset. AVRLib has been used for displaying the map on the graphical lcd.I2C protocol has been used for storing the map on an external EEPROM. Interrupt driven keypad has been developed for the user to navigate through the map.

Salient Features & Innovation
- Displays present location on the map.
- 64K External Memory (EEPROM) for loading map of any region.
- Provides zoom of 9x.
- Scroll in all four directions.
- Shortest path between two locations.

Use of tech/science developed
- LCD Assistant Software to create a database of map.
- VRLib to display map on Graphical LCD.
- WinAVR to program the microcontroller.
- DockLight to verify GPS chipset.
- AT29C04A External Flash Memory in first model.

Conclusion & Future Work
We learnt a lot from the project. Many functional features were not effectively implemented in the final model due to unoptimised code. A fully functional navigation device along with 3D view can be developed. Using a GSM chipset the navigator can be transformed into a tracker.

Acknowledgements
We would like to thank our mentor, Chirag Sangani, for his guidance and the Electronics Club Coordinators, Abhinav Prateek and Sumeet Kumar, for their valuable inputs and guidance which they provided us.

We would also like to thank Kshitij Deo and Brics Office for providing us very useful information about the GPS chipset.

Reference/weblinks for further information

Team Members
Manu Agarwal (manuagr@iitk.ac.in)
Ganesh Pitchiah

Nitin Goenka (nitishg@iitk.ac.in)

About the Author
Ganesh Pitchiah is a second year undergraduate in the Department of Electrical Engineering at IIT Kanpur. He can be contacted at ganeshp@iitk.ac.in or ganesh819@gmail.com. His technical interests lie in Virtual reality, Computer architecture and Embedded Systems. His team is currently working on virtual reality.
Fuzzy Logic Based-Traffic Control System

Introduction:
The automotive technologies are gaining ground in today’s scientific scenario. Since road passengers and vehicles are growing drastically, there is a perpetual need for safety. This project is mainly meant to support the development of reliable and perpetual flow of the urban traffic. Controlling the traffic is mainly based on the behavior of human beings which is full of uncertainties. Therefore a stochastic (full of uncertainties with finite variance) approach has to be applied in order to solve this problem. Fuzzy logic (defined later) has been proved to be an extraordinarily handy tool to incorporate the artificial intelligence in the electronic systems. It will require a sophisticated algorithm which could provide a proper decision after analyzing the traffic of an urban road.

What is Fuzzy Logic?
When you say it will rain today or that you will have an outdoor picnic today, you are making statements with certainty. Of course your statements in this case can be either true or false. The truth values of your statements can be only 1, or 0. Your statements then can be said to be crisp.

On the other hand, there are statements you cannot make with such certainty. You may be saying that you think it will rain today. If pressed further, you may be able to say with a degree of certainty in your statement that it will rain today. Your level of certainty, however, is about 0.8, rather than 1. This type of situation is what fuzzy logic was developed to model. Fuzzy logic deals with propositions that can be true to a certain degree—somewhere from 0 to 1. Therefore, a proposition’s truth value indicates the degree of certainty about which the proposition is true. The degree of certainty sounds like a probability (perhaps subjective probability), but it is not quite the same. Probabilities for mutually exclusive events cannot add up to more than 1, but their fuzzy values may.

Motivation:
Our zeal for automation of human tendencies inspired us to look forward to a project which could perform human intelligence tasks and give an impression of HUMAN AT WORK. We chose traffic control system because it beautifully demonstrates the decision making sense of humans. It can be restructured to work in practical arena where dynamic data control is at present controlled by human brain.

Prior Art:
Traffic signals in current use typically operate on a preset timing schedule. The most common traffic control system used in the United States is the Urban Traffic Control System (UTCS), developed by the Federal Highway Administration in 1970’s. UTCS uses a central computer to generate timing schedules off-line based on average traffic conditions for a specific time of day.

In early 1980’s the systems were developed which can respond to changing traffic demand. The most notable of these are “Sydney Coordinated Adaptive Traffic System” (SCATS) developed in Australia and “Split Cycle and Offset Optimizing Technique” (SCOOT) developed in England.

Experimental Design:
Our experimental hardware mainly consists of:
- Cardboard designed in the form of intersection of an urban road.
- TSOP Sensors (An infrared receiver which is capable of receiving infrared radiation modulated at 36KHz Only) to detect the saturation of each lane.
- Microcontrollers to implement the designed fuzzy logic based algorithm.
- LEDs to show the traffic signals.

Salient Features & Innovation:
Prior traffic control systems rely on the centralized or regional computer control which cannot respond to the unpredictable changes in the traffic conditions effectively. So there is the need of the developing the effective, fault – tolerant, adaptive and self - organizing traffic signal control system that is based on local traffic data and localized computer control.

Our project comprises of the microprocessor based adaptive traffic signal control system that uses fuzzy logic. The system can control multiple intersections in a network of two way streets. Traffic signal timing at each intersection is defined by cycle time and phase split (explained later). Traffic flow data is input to the system which is detected through the TSOP sensor. This kind of scenario helps us give the adaptive control over the unpredictable system of road traffic.

Algorithm Used:
Fuzzy logic decision rules are being applied to the input data and used to control signal control parameters at each intersection. These parameters are:
1. Cycle time: Adjusted to maintain good degree of saturation.
2. Phase split: Adjusted to maintain similar degree of saturation in competing
approaches.

3. The fuzzy logic decisions are typically expressed in the form:
   If $X_1$ is $A_i$ and $X_2$ is $A_j$, then $U$ is $B_k$.
Where $X_1, X_2 = \text{Input}$
$A, B$ are membership function
$i$ denotes the rule number
For a given $X_1$ and $X_2$ the degree of fulfillment of rule $i$ is given as:
$D_{Fi} = \min\{A_i(X_1), A_j(X_2)\}$
Where the output $U$ is computed as:
$U = \sum D_{Fi} B_k / \sum D_{Fi}$
Where $i$ varies from 1 to $n$
$n$ are the number of rules.
$B_k$ represents the defuzzified value of membership function characterization $B_k$.
Defuzzified value is the single value that best represents the linguistic description.
Centroid is generally taken as defuzzified value.

4. Degree of Saturation: The degree of saturation for a given approach is defined as
the actual number of vehicles crossing the intersection in the given time interval of green light divided by the maximum number of vehicles that can pass in the given time interval.

5. The cycle time is adjusted to maintain a given degree of saturation. Its reason is to control delay and stops of the traffic on the intersection.

6. When the traffic volume is low the cycle time must be reduced to maintain given degree of saturation. This results in short cycle time that reduce the delay in waiting for phase changes.

7. When the traffic volume is high the cycle time will be increased to maintain the same degree of saturation. This results in long cycle time which reduces the stops of the vehicles.

8. The phase split is adjusted to maintain equal degrees of saturation on competing approaches.

9. The offset time is adjusted in such a way that minimizes the stops in the direction of dominant flow.

Rules to decide the cycle time:

- highest_sat = The highest degree of saturation on any approaches
- cross_sat = The highest degree of saturation of on competing approaches

Rules to decide the phase split time:

- sat_diff = The difference between the highest degree of saturation on east - west approaches and the highest degree of saturation on north - south approaches.
- Highest_sat = The highest degree of saturation of any approach.

Conclusion & Future Work:

<table>
<thead>
<tr>
<th>Highest_sat</th>
<th>Cross_sat</th>
<th>Cycle_change</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td>n.big</td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td>n.mid</td>
</tr>
<tr>
<td>Slightly Low</td>
<td></td>
<td>n.low</td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td>zero</td>
</tr>
<tr>
<td>High Not High</td>
<td>p.low</td>
<td>p.med</td>
</tr>
<tr>
<td>Saturated</td>
<td>p.med</td>
<td>p.big</td>
</tr>
</tbody>
</table>

The above described algorithm worked just fine on our hardware model. The signal timings were dependent on the local traffic density in each lane at the crossing which was counted by the interruption caused in the TSOP sensors. Further improvement of the algorithm to optimize traffic flow will make the system more robust and adaptive. Fuzzy logic is much easier than the propositional logic and has wide range application in neural networks and artificial intelligence.

Acknowledgments:

We extend our heartfelt thanks to the Electronics Club Coordinators for their precious guidance and support. To our mentor Abhinav Prateek we are grateful for his motivation at every move and also for valuable technical consultation. We also acknowledge SnT Council for helping us to take this
project.

References:
- Fuzzy logic with engineering applications (Timothy J Ross)
- SCATS:
  - SCOOT: http://www.scoot-utc.com/

Team Members:
- Pragyanandesh Narayan Tripathi
- Nitesh Kumar (niteshkr@iitk.ac.in)
- Palash Jain (paljain@iitk.ac.in)

About the Author
Pragyanandesh Narayan Tripathi is a second year undergraduate in the Department of Electrical Engineering at IIT Kanpur. He can be reached at pragya@iitk.ac.in. His technical interests involve digital and embedded systems and web application.
Black Hole

Introduction
Black holes are a very recent discovery in the field of astrophysics. It has interested physicists and given them many sleepless nights. But can you imagine that the word ‘black hole’ was first used in the books of British History of India? Nowadays, however, it is only used in an astrophysical context. What are black holes, actually? They are heavenly bodies whose gravitational field is so strong that even light cannot escape from them.

Formation of Black Holes
Black Holes generally form due to the collapse of a star. After all the hydrogen in a star gets converted to helium, it starts collapsing till its temperature rises enough for the fusion of helium. Large enough stars with such repeated stages of collapsing and fusion ultimately form iron at their cores. Now the star is ready to blow off in the form of a supernova. This is because in the fusion of iron, energy is absorbed and with no energy produced in the core, the star collapses with the outer layers being hurled out in a titanic explosion. The core, however, continues to shrink.

When the core becomes very small, matter particles get very near to each other, and so according to Pauli’s exclusion principle, they must have different speeds. When a substance gets really dense such that the de-broglie wavelength becomes greater than the inter particle distance then the particles become essentially indistinguishable and this can only be taken care of with the application of quantum mechanics. This makes them move away from each other, which results in the expansion of the star. We can compare this tendency with a force that is pushing the star outwards. This force is defined as the degeneracy force. Thus equilibrium is reached between the gravity and the degeneracy pressure. However, there is a limit to the repulsion between the matter particles that the degeneracy pressure can provide. Theory of relativity states that the maximum relative velocity between two particles cannot exceed the speed of light, which means degeneracy pressure cannot balance the gravitational attraction in stars of any mass. Chandrasekhar calculated that if the core of the star is balanced by the electron degeneracy pressure, the maximum mass of a stable star is 1.4 times the mass of sun.

Landau calculated another final state which is balanced by exclusion principle among neutrons, and raised the bar to about two to three solar mass. Beyond this limit, there is nothing to stop the star from collapsing into a black hole.

Black holes of smaller masses are also possible, which are formed due to presence of external forces arising from the irregularities of early universe.

So the main principle behind formation of a black hole is that the compressive and attractive force (due to the gravitational force) should exceed the repulsive forces (due to so called degeneracy pressure).

Classical Ideas about Black Holes

Boundary of black hole
According to the classical model, the boundary around the black hole, at which the escape velocity is just greater than the speed of light, is called the event horizon. We know that the escape velocity of a body is $v_{esc} = \sqrt{\frac{GM}{R}}$. For a black hole, $v_{esc} = c$, so $R = \frac{2GM}{c^2}$, which is the radius of the black hole. Since velocity of light is greater than any object in the universe, nothing can escape from black hole. So it was believed that once anything goes inside black hole, no information can be obtained about it from the outside. Also it was believed that the black hole would continuously shrink and disappear, thus all information inside it will disappear forever.

Problems in the classical model
For a minute, come back to earth and throw a stone upwards in your imagination. What will you observe? You will see that the stone decelerates, stops and comes back. Since it comes back, you deduce that the velocity of stone is less than the escape velocity. Now imagine yourself standing on the event horizon. You send a pulse, just as you threw a stone on earth. The light will keep on losing energy (i.e. undergo gravitational redshift) continuously. At one point the frequency of the light will become zero. So if we keep a receiver before that point, we can receive information about black hole, which defies the very definition of the black hole. Also, according to the classical theory, the black hole just vanishes from the universe without leaving any clue that it existed previously. All the mass present inside it along with the information disappears with it. This is against the conservation of mass and energy.

Modern ideas about black hole
On the debris of the classical model, the towers of modern theory have been built. Following is the description of the basic building blocks of this modern model.
4.1 Schwarzschild Barrier

To understand the schwarzschild radius in detail, let us do a simple thought experiment. Let us assume that astronaut B is on a collapsing star and is sending signals to astronaut A, who is at rest with respect to the background of stars. Let us also assume that astronaut C is on the surface of the star but is at rest with respect to A. C is receiving a signal from B and is transmitting it to A.

\[ ?c = k ?B \]

where \( k \) is the doppler factor.

Again, from the general theory of relativity,

\[ \frac{v_u}{v_c} = \sqrt{1 - \frac{2GM}{c^2R}} \]

where \( M \) is the mass of the star and \( R \) is the radius of the star.

So

\[ \frac{\lambda_c}{\lambda_A} = \sqrt{1 - \frac{2GM}{c^2R}} \]

which implies

\[ \lambda_A = \frac{k \lambda_B}{\sqrt{1 - \frac{GM}{c^2R}}} \]

So the signal received by A will be continuously redshifted, and when the radius becomes

\[ R = \frac{2GM}{c^2} \]

the wave will be infinitely redshifted. The wave emitted by B will spread out over an infinite time, and A will never receive it. So the radius of a Schwarzschild black hole, which is nonrotating, charge less and spherical, is approximately \( \frac{2GM}{c^2} \). This, interestingly, is the same as calculated classically by setting escape velocity equal to speed of light.

Now let us consider a case in which a black hole is in an isolated condition. If light rays at the event horizon move towards each other, they will eventually fall into the singularity (in this context singularity is defined as the point or a line towards which the incoming matter falls) of the black hole. This implies that the light cannot be at the event horizon, which follows from the definition. Because now we define event horizon as the boundary on which light will always hover around but can escape from the black hole. Therefore light rays at the event horizon can only move parallel or away from each other. This means that the area of the event horizon will never decrease. Now this property is identical to the non-decreasing property of entropy. So there is a possibility that the surface area of event horizon of a black hole is a measure of its entropy, and it turns out to be actually true.

Suppose one observer takes some particle and throws it at the black hole. Previously, there was no way of finding out whether entropy of black holes increased, so it seemed like the entropy of the universe had decreased. This violated the second law of thermodynamics. The non decreasing property of the surface area solves our problem.

Black holes are not so black!

Recent investigations by Dr. Stephen Hawking, Dr. Jacob Bekenstein and many other scientists have proved that black holes actually emit particles. Here is the explanation. Classically, what we call vacuum is not actually vacuum. If it had been vacuum, then energy and rate of change of energy would have both been zero, which is prohibited by the uncertainty principle. Actually, in vacuum particle pairs of positive and negative energy are created and annihilated. However, in presence of a black hole, due to its high gravitational field, even real particles can have negative energy. So it is possible for a virtual particle to fall into a black hole and become a real particle or antiparticle. Then it will not have to annihilate its partner. Its forsaken partner can either fall into the black hole or escape from it. It will appear to a distant observer that a particle has been emitted from the black hole. Since equal number of particles with negative energy fall into black holes, its mass will actually decrease.

Now this emission follows Planck’s law and fits the statistics very well. Hawking, taking into account...
different processes, came to the conclusion that a black hole of surface gravity $\kappa$ radiates like a black body with surface temperature $T = \frac{\hbar K}{4p^2c^2k_B}$. Let us use this relation to derive various quantities for the special case of the Schwarzschild black hole of mass $M$.

\[ K = \frac{GM}{R_s^2} = \frac{c^4}{4GM} \]

\[ \therefore T = \frac{\hbar c^3}{16p^2Gk_Bm} = \frac{\hbar c^3}{8pGMk_B} \]

A black hole of mass few times the mass of sun has temperature of the order of $10^{-8}K$, which is called the Hawking temperature. Again,

\[ dS = \frac{dQ}{T} = \frac{8pGMk_BdQ}{\hbar c^3} \]

Now heat energy that enters serves increase of mass

\[ dQ = c^2dM \]

\[ \therefore dS = \frac{4pGk_BdMdM}{\hbar c} \]

\[ S \propto M^2 \]

So energy radiated from black hole per second

\[ P = 4pR_s^2T^4 = \frac{\frac{\hbar c^5}{15360pGM^2}}{M^2} = \frac{K_{ev}}{M} \]

But for a black hole to completely evaporate, there are several complications. First of all its temperature should be greater than the temperature of the cosmic microwave background. A few solar mass black holes would have a temperature only one ten millionth of a degree above absolute zero, much below the cosmic background temperature of 2.7K. So the black hole would radiate less than it absorbs. If the universe is destined to expand, then at one time the temperature of background radiation comes below temperature of black hole. Only then it radiates more than it absorbs.

\[ P = -\frac{dE}{dt} = -\frac{k_{ev}}{M^2} \]

\[ \therefore \frac{dE}{dt} = \frac{c^2dM}{dt} \]. Setting these equal, we get

\[ \therefore c^2 = \frac{k_{ev}}{M^2} \Rightarrow t_{ev} = \frac{5120pG^2M^3}{\hbar c^4} \]

For a black hole of 1 solar mass, the time to evaporate would be $10^{57}$ years, which is much more than the age of the universe. But the primordial black holes having a much smaller mass and radius radiate at a much larger rate. Primordial black holes with an initial mass of $10^9$ tons have lifetime roughly equal to the age of the universe. Black holes with slightly greater mass radiate in form of x rays and $\gamma$ rays at a rate of $10^4$ megawatts. The surprise is that as mass decreases, they radiate at an increased rate ($\therefore \frac{dE}{dt} \cdot \frac{1}{M^2}$).

**Conclusion**

Black holes are one of the few topics in physics which have been developed purely through maths. But there is more to do. Daily new articles are being written, old theories are being discarded and new are propagated. Through this we can proceed towards complete understanding. Let’s hope for the best, and wait for someone like Hawking to crack something revolutionary.

**About the Author**

Surajit Mondal is a student in the Department of Physics at IIT Kanpur. He can be contacted at surajit@iitk.ac.in He is interested in astrophysics.
God is a mathematician, isn’t he? We came across ‘Divine Proportion’ or Phi in Dan Brown’s Da Vinci Code, which aroused our curiosity into finding an answer to this question. Let me add another dimension to this argument by introducing you to the beautiful world of Fractals.

“Fractal geometry will make you see everything differently. There is a danger in reading further. You risk the loss of your childhood vision of clouds, forests, flowers, galaxies, leaves, feathers, rocks, mountains, torrents of water, carpet, bricks, and much else besides. Never again will your interpretation of these things be quite the same.”

— Michael F. Barnsley

A fractal is an endlessly repeating pattern that varies according to a set formula, a mixture of art and geometry. It is any pattern that reveals greater complexity as it is enlarged. A close observation may lead us to deduce it as a “Geometry of Nature” which can be used to make precise mathematical models of physical structures varying from surface of ores to clouds and even galaxies.

I explored the wonderful world of fractals in summers of 2010 as a project under Programming Club, IIT Kanpur. My project was to create an exhaustive fractal generator named FracGEN. The entire code was built brick by brick in Python using various modules like Tkinter, Matplotlib, Pygame, Numpy, Psyco, Scipy, VPython etc. In my project, Iterated Function Systems (IFS) are employed to construct various fractals using a recursive application of a particular function in each case.

Few Fractals I generated are described below.

**Geometrical Fractals:**

1. **Koch Snowflake:**

The Koch snowflake is a mathematical curve and one of the earliest fractal curves to have been described.

I generated it using the following algorithm:

Start with an equilateral triangle and recursively alter each line segment as follows:

1. Divide the line segment into three segments of equal length.
2. Draw an equilateral triangle that has the middle segment from step 1 as its base and points outward.
3. Remove the line segment that is the base of the triangle from step 2.

The Koch curve is the limit approached as the above steps are followed over and over again (figure 1).

In mathematics, the T-square is a two-dimensional fractal. Like all the two-dimensional fractals, it has a boundary of infinite length bounding a finite area. Its name follows from that for a T-square.

It can be generated from using this algorithm:

Figure 1

Figure 2
script which runs on each click generating more squares in the zoomed region. This process enables one to go on and on ad infinitum. Thus you can zoom as long as you like and the quality of zoomed region is never compromised.

The circle in figure 3 is zoomed as figure 4 and the circles of figure 4 and 5 are zoomed as figure 5 and 6 respectively.

**Complex Fractals:**

1. Complex Fractal Set:

   ![Figure 3,4,5,6 clockwise from top left](image)

In mathematics the **Mandelbrot set** is a set of points in the complex plane, the boundary of which forms a fractal. Mathematically the Mandelbrot set can be defined as the set of complex values of c for which the orbit of 0 under iteration of the complex quadratic polynomial $z_{n+1} = z_n^2 + c$ remains bounded.

I first designed my code to generate the Mandelbrot Set, but as time progressed the code was generalized for any function $f(z)$ entered by the user which led to the iteration $z_{n+1} = f(z_n)$. Hence a customized fractal set was obtained.

Figure 7 shows that $f(z) = z^3 + j$ is entered in the dialog box. Here $z$ is a complex variable and $j$ is complex square root of -1.

Figure 8 shows the corresponding fractal set with a region selected for zooming. Figure 9 shows the zoomed region. (Can you identify the recurring pattern?). Figure 10 shows another selected region. Figure 11 shows the zoomed region. (Numerous Teddy Face kind of pattern still persists.)

If this zooming process is continued over the boundary again and again the pattern repeats itself till a zoom factor of $10^5$X is reached.

1. Wada Basins and Newton’s Fractal:

The Newton fractal is a boundary set in the complex plane which is characterized by Newton’s method applied to a fixed polynomial $p(z) \in \mathbb{C}[z]$. It is the Julia set of the meromorphic function $z \to z - p(z)/p'(z)$ which is given by Newton’s method. The Newton fractal is similar to the Mandelbrot set, and like other fractals it exhibits a complex appearance arising from a simple description.

Newton’s Fractal follows the colouring scheme in which we colour the escaping points taking into account the root reached. For example, if the equation is $z \to z^3 - 1$. We will apply the Newton’s method on the complex numbers in the plane. They will converge to any of the roots $1, \omega$ or $\omega^2$. So the points converging to three different roots are coloured in three different shades giving rise to 2 Dimensional Wada Basins of attraction, which are basin like formations.

It begins with a dialog box asking for the value of $p(z)$ which is a polynomial in $z$ (in our case $p(z)$ is entered as $z^3 - 1$). FracGEN allows a maximum of 5th degree polynomial, thus a maximum of 5 roots corresponding to which I have assigned 5 colour shades.

Corresponding Wada Basins with three colours generated. This complex plane extends from -2 to +2 along the real axis and from -2i to +2i along the imaginary axes. You can see three large basins filled with green, red and blue colour. In these basins the dark coloured spots are the corresponding roots of
p(z), 1, ω and ω². Thus the points on the plane converging to 1 are assigned shades of blue, those converging to ω are shaded red and those points converging to ω² are assigned shades of green.

Selected area in figure 13 is zoomed as figure 14. Selection in figure 15 produces figure 16. You might have figured it by now that the boundary of each basin is made of infinite such smaller basins.

3D Fractals:
1. Menger Sponge:

Construction of a Menger sponge can be visualized as follows:

1. Begin with a cube (figure 17)
2. Divide every face of the cube into 9 squares, like a Rubik’s Cube. This will sub-divide the cube into 27 smaller cubes.
3. Remove the cube at the middle of every face, and remove the cube in the center, leaving 20 cubes, resembling a Void Cube (figure 18). This is a level-1 Menger sponge.
4. Repeat steps 1–3 for each of the remaining smaller cubes.

The second repetition will give you a level-2 sponge (figure 19), the third a level-3 sponge (figure 20), and so on. The Menger sponge itself is the limit of this process after an infinite number of iterations. The number of cubes is 20^n, with n being the number of iterations performed on the first cube.

The algorithm to construct these 3D fractals is simple and there are numerous permutations and combinations possible with different shapes. Some such possibilities are shown below:

Future scope:
If you wish to extend my project there is still a lot of scope like - 3D Tree; Mandelbulb; 4D fractals; Nebulabrot; Integration with microphone, webcam and games. Opportunities are like fractals infinite, you just need to grab them.

About the author:
Ankit Mahato is a second year undergraduate in the Department of Mechanical Engineering at IIT Kanpur. He can be reached at amahato@iitk.ac.in. His interests lie in CAD, computer vision, fractals and computational complex analysis.
The Amphibious Adventure

Introduction
This project was primarily about making a Remote Controlled (RC) bi-fuselage plane with amphibian characteristics i.e. it can land on and take-off from land as well as water; while dealing with drag forces provided by both air and water.

Motivation
Amphibious planes are unique to their kind. They add a lot to basic aeromodelling techniques and dealing with both land and water is a challenge in itself. Also, they are extremely useful in connecting remote areas like islands and in rescue operations. The spirit of trying something new, useful and different motivated us to pursue this idea.

Ideas
Familiar with the making of a simple RC plane, our main focus was to make our plane stable enough to be able to land on water. We chose to go for bi-fuselage structure as it provides a more stable form. Also protecting the vital components from water was a task to look about.

Various issues
1. First we thought of giving the base the shape of a boat, ignoring the horizontal stabilizer which would also give protection to internal parts, but it greatly increased the mass of plane making it non-feasible.
2. To protect IC (internal combustion) engine we even thought of making a double wing and placing the engine between both of the wings so that it stays away from water but, it provided a lot of drag to the plane in air.
3. Engine and servos (control motors) are the most crucial parts and the foremost focus was preventing them from any damage that water can cause. We finally decided to attach fuselage on top of the wing thus giving the plane added height, also preventing contact of the propeller with water. Also, drag due to water is much more than that of air.
4. We also considered making a 3-D hollow structure for both the fuselages that would facilitate them to float, but the dimensions and weight of the plane didn’t allow us to implement that.

Basic Design
The basic design of our project included a bi-fuselage plane with two sets of vertical stabilizers, rudders, a common main wing and horizontal stabilizer.

Additional Features
The distinguishing features of this plane were the bottles which would act as floats to provide necessary buoyancy.

We used a pair of small floats at the back and two pairs in front designed in boat shape for easy floating.

Why a Bi-fuselage?
We came up with the design of a bi-fuselage plane because it would provide extra stability and ease in fixing floats. Bi-fuselage is also strong enough to support large wing span needed for extra lift.

Achievements
1. Successful test of the plane has been carried out in water. The floats used were able to keep the plane afloat even after sufficient hand-pull provided.
2. This plane has also seen a successful ground run indicating our ideas of using long landing gears and servo threads worked well.

Future Prospects
The main intention behind our working on this project was to understand the effect of the two fluids: air and water on the plane. A more powerful engine
could enable it to take off from water. Even more efficient floats could have been made using hollow cans.

Our suggestion to anyone taking such project in future is that he should follow the same ‘try and apply’ method to come up with an efficient design.

**About the authors**

Palash Jain is a second year undergraduate in the Department of Aerospace Engineering. He can be reached at paljain@iitk.ac.in. His interests lie in avionics and embedded designs.

Ankita Asai is a second year undergraduate in the Department of Biological Sciences and Bioengineering. She can be reached at asaiank@iitk.ac.in. Her research and technical interests lie in structural design.

Yash D. Jaiswal is a second year undergraduate in the Department of Aerospace Engineering. He can be reached at yjaiswal@iitk.ac.in. His research and technical interests are propulsion, aeromodelling, structure, flight mechanics and aerodynamics.

Sohini Chaparala is a second year student in the Department of Humanities and Social Sciences.

Mridul Mishra is a second year undergraduate in the Department of Aerospace Engineering. He can be reached at mridulm@iitk.ac.in. His interests lie in aerodynamics and propulsion.

Abhishek Gupta is a second year undergraduate student in the Department of Electrical Engineering, IIT Kanpur.
The Styrofoam Plane

Problem Statement
We had to build a remote controlled plane made of styrofoam which could fly, glide and perform some simple manoeuvres.

Designing Aspects
We used Design Foil software to design the wing. This software is open source and it is used to get the airfoil shape of the wing provided some parameters. Wings’ specifications were NACA© 9412-63, chord length was 17 cm and wing span was 110 cm. Fuselage was 80 cm long, area of horizontal stabilizer was 605 cm² and area of vertical stabilizer was 300 cm².

Building the Plane
We cut out all the parts of the plane according to the above designing aspects. For assembling them, we carved out spaces to attach battery, receiver and servos in the fuselage, and then attached the wing to the fuselage. For thrust generation, the propellers were mounted on the head part of the fuselage, to be rotated with the help of electric motor, and stabilizers were mounted with elevators at the rear part of the plane.

Difficulties Faced
1. We had to make two identical 55 cm wing halves using styrofoam. Giving a 55 cm styrofoam airfoil shape proved to be too difficult.
2. Attaching the three servos in less space in the fuselage was also a very hard task.
3. Synchronising the motion of the servos and corresponding control surface (ailerons, rudder, elevators) had to be carried out with great care.

There were many other minor difficulties faced during the completion of the project which I don’t think need a mention.

**Task completion Video**
The video of the flying RC Plane can be viewed from here:
http://www.youtube.com/watch?v=qwRRdvNnKOQ

**Reference**
The NACA four-digit wing sections define the profile by:
1. One digit describing maximum camber as percentage of the chord.
2. One digit describing the distance of maximum camber from the airfoil leading edge in tens of percentages of the chord.
3. Two digits describing maximum thickness of the airfoil as percent of the chord.

For example, the NACA 9412 airfoil has a maximum camber of 9% located 40% (0.4 chords) from the leading edge with a maximum thickness of 12% of the chord.

1. Chord refers to the imaginary straight line joining the trailing edge and the centre of curvature of the leading edge of the cross-section of an airfoil and the length of this line is known as chord length.
2. Fuselage is the central body of an aircraft, to which the wings and tail assembly are attached and which accommodates the crew, passengers.

3. The **wingspan** of an airplane is the distance from one wingtip to the other wingtip.
4. The stabilizer provides stability when the aircraft is flying straight, and the airfoil of the horizontal stabilizer balances the forces acting on the aircraft.

5. Elevators are flight control surfaces, at the rear of an aircraft, which control the aircraft’s orientation by changing the pitch of the aircraft.

For more information about making RC Plane you can visit the following links:
http://students.iitk.ac.in/aeromodelling/
http://www.rcindia.org/electric-power/understanding-electric-power-systems/
http://www.modelaircraft.org/mag/FTGU/titlespa
gftgu.htm

**About The Author**
Amit Kumar is a second year undergraduate in the Department of Aerospace Engineering. He can be contact at amitkrao@iitk.ac.in. His research and technical interests lie in aerodynamics of low speed aircraft.

Dhriti Bhatt is a second year undergraduate in the Department of Mathematics and Statistics. She can be reached at dhritib@iitk.ac.in. Her interests lie in probability and statistics.
Remote Controlled Ornithopter

Introduction
Ornithopter can be thought of as a remote controlled mechanical bird or a glider that can flap its wings. Ornithopter flies like a kite and not like a sparrow i.e. it glides due the shape of the airfoil (cross-sectional shape of the wing). It is more efficient than a normal glider or propelled aircraft or helicopter.

Basic Design
We decided the shape of the airfoil arbitrarily, without the use of Design Foil software, as we just needed a curve in the leading edge i.e. the front edge of the wing. The other details hardly mattered.

The main hindrances were:
1. The torque provided by the motor was not enough to sustain each individual wing weighing 80 grams. They flapped when in vertical orientation, but they gave in under gravity and in horizontal orientation.
2. The gears slid over each other which stopped the flapping.

Solution
We reduced the dimensions of the wing span to two-third the original. The chord length, which is the line connecting leading and trailing edge, was also slightly reduced and the wing was truncated to the second largest airfoil so as to make the weight sustainable as per the input torque.

Ideally one should be using a very high torque motor as to make the flapping rate at least 3.5 flaps per second. The motor should have at least 300rpm at 8Volts.

Structure

1. Wings - We cut out two wing spans, each 75cm long, out of a 9mm balsa wood. We needed three airfoils per wing of different lengths. Spacing between the airfoils was 16cm and 16.5cm respectively. Sheets of flexible cardboard were rolled along their length and stuck along the leading edge.

2. Tail - Construction included two ruddervators attached to two corresponding fins that were fixed at a dihedral angle of 120 degrees for stability. The ruddervators are flexible and can move up and down for left and right motion. The fuselage (main body) part of the tail was approximately 40cm in length and made to taper towards the end. Also windows were cut off to reduce weight. Then fins and ruddervators were covered with balsa wood and plastic sheet. Then a sheet of plastic, cut in the shape of the wing, was stuck on the top only, and attached over the cardboard sheets at the bottom.

Equipments and their partial mechanism

1. The motor used unfortunately did not have a very high torque. We used an 87:1 90 degree shaft motor. This motor would run (no load) at 250 rpm and on one LiPo battery. The weight of the motor was 40grams.

2. Two gears one connected to the shaft of the motor and the other which was jammed into it was taken through an aluminium rod, at whose ends two biscuits with holes at alternate positions for attaching the connecting rods for the flapping mechanism were used.

3. An 8.4V Li ion battery which runs with 1400milli ampere-hour power.

4. A servo, a device to provide control of a desired operation, through use of feedback.

Mechanism of ruddervators:
The servo was attached in the tail with long cycle...
Other problems faced and future potential

1. A 20grams mini servo reduces the size of ornithopter considerably eradicating the weight issues faced. But we had to use 45grams Futaba servos due to availability issues.

2. A stronger material is required for the desired mechanism. Else the mechanism will constantly break under load conditions and flapping.

3. Battery adds a lot to the weight and also the motor generally used is a brushless motor which is quite expensive and has a comparatively high torque.

About the authors

Piyush Negi is a second year undergraduate in the Department of Aerospace Engineering. He can be reached at piyushae@iitk.ac.in.

Ajinkya Desai is a second year undergraduate in the Department of Aerospace Engineering.

80m [3.57 MHz] Double Side Band [DSB] Amateur Band Transmitter

Introduction

In electronics and telecommunications a transmitter or radio transmitter is an electronic device which, with the aid of an antenna, produces radio waves. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. When excited by this alternating current, the antenna radiates radio waves. In addition to their use in broadcasting, transmitters are necessary components of many electronic devices that communicate by radio, such as cell phones, Wi-Fi and Bluetooth enabled devices, garage door openers, two-way radios in aircraft, ships, and spacecraft, radar sets and navigational beacons. The term 'transmitter' is usually limited to equipment that generates radio waves for communication purposes; or radiolocation, such as radar and navigational transmitters. The term is popularly used specifically to refer to transmitting equipment used for broadcasting, as in radio transmitter or television transmitter. This usage usually includes both the transmitter proper as described above, and the antenna, and often the building it is housed in.

An unrelated use of the term is in industrial process control, where a "transmitter" is a device which converts measurements from a sensor into a signal, and sends it, usually via wires, to be received by some display or control device located a distance away.

A transmitter can be a separate piece of electronic equipment, or an electrical circuit within another electronic device. A transmitter and receiver combined in one unit are called transceiver. The term transmitter is often abbreviated "XMTR" or "TX" in technical documents. The purpose of most transmitters is radio communication of information over a distance. The information is provided to the transmitter in the form of an electronic signal, such as an audio (sound) signal from a microphone, a video signal, or devices a digital signal from a computer as in wireless networking. The transmitter combines the information signal to be carried with the radio frequency signal which generates the radio waves, which is often called the carrier. This process is called 'modulation'. The information can be added to the carrier in several different ways, in different types of transmitter. In an amplitude modulation (AM) transmitter, the information is added to the radio signal by varying its amplitude (strength). In a frequency modulation (FM) transmitter, it is added by varying the radio signal's frequency slightly. Many other types of modulation are used.

Motivation

We were using the transmitter in Foxhunts
hunting is an activity involving the tracking, chase of a fox with the help of signal passed by it through transmitter) in frequency range 144 -146 MHz, which is very costly (costs around Rs. 10,000). Then we thought of making it ourselves, but after seeing the difficulties involved in it, we thought of starting with a transmitter having small frequency band.

Techniques and Development
The development of aerial communication is the result of experiments carried out by amateur radio experimenter. Infact the core for the development of modern military communication equipments was provided by the technical progress made by the radio amateurs [hams]. The Single Side Band [SSB] transmission technique is one of them.

The project we gave a try was a low power DSB [Double Side Band] voice transmitter. The transmitter was an attempt in line of the original BITX transceiver developed by Mr. Ashar Farhan and later improved version [version3] developed by Shri Rahul Srivastava, VU3WJM(Asher Farhan and Rahul Srivastava both are Ham and are involved in making Ham Radio Equipment).

BITX - An easy to build 6 watts SSB transceiver for 14MHz

BITX is an easily assembled transceiver for the beginner with very clean performance. Using ordinary electronic components and improvising where specific components like toroids are not available, it has a minimum number of coils to be wound. All alignment is non-critical and easily achieved even without sophisticated equipment. The entire instructions to assemble the rig are given here along with relevant theory.

The Indian hams have often been handicapped by the lack of low cost equipment to get them on air. A mono-band, bidirectional design using ordinary NPN transistors was developed to cater to this demand. The design can be adapted to any particular ham band by changing the RF section coils and capacitors and the VFO frequency.

This project may be an initiation into assembling of a fully working prototype of an efficient SSB [Single Side Band] mode of transmission.

[a] RF Oscillator: This is the stage where the radio frequency carrier wave intended to be used is generated by means of a Crystal Oscillator circuitry. The RF oscillator is designed to have frequency stability and power delivered from it is of little importance, hence can be operated with low voltage power supply with little dissipation of heat. We are using a 3.57 MHz Crystal for the oscillator in Colpitts configuration [where two capacitors are used in the tank circuit instead of tapped coils]. The signal generated by this oscillator (Q1) is buffered to an emitter follower (Q2).

[b] Buffer Amplifier: Buffer amplifier helps in amplifying the RF Oscillator signal while at the same time keeps the RF oscillator circuit separated electrically from the Power Amplifier Circuit helping to avoid overloading of the crystal oscillator and thus greater frequency stability.

[c] Modulator: Audio information is impressed upon the carrier frequency at this stage. Q3 amplifies the signal from the Condenser Microphone. The resulting DSB output is applied to a 3 dB pad consisting of R1 and R2 in order to maintain fixed impedance and the output from this pad is coupled to a RF amplifier (Q4). The Modulator is also provided with the low frequency audio signal from their microphone amplifier based on Q3.

[d] Balanced Modulator: The carrier signal is applied to a Balanced Modulator based on diodes D1 and D2 with trifilar transformer T1.
for balancing of the modulator circuit. In a balanced modulator, while the audio information is impressed upon the carrier frequency, at the same time its output gives a signal without a carrier frequency but yet with the two side band frequencies carrying the voice/audio information.

RF amplifier: RF Amplification is done here where Q4 operating in Class A mode for good linearity with transformer T2 at the collector of Q4 matches the signal to the 50 Ohms antenna.

About the Author
Manish Kumar is a second year undergraduate in the Department of Chemical Engineering. He can be contacted at manishmu@iitk.ac.in. He is interested in making transmitter-receiver systems and learning different communication languages like Q-code language, Morse code etc.
TAKNEEK

Takneek is the intra-IITK science and technology championship - a perfect platform for the catharsis of our inner geeky feelings, an event where once in a year we lock heads with our peers inside the campus to prove our mettle! As a part of the general championship, Takneek puts the different hostels of IITK at logger heads with each other, creating a healthy competitive atmosphere which inculcates team spirit and puts personal achievements in tandem with team accomplishments. It comprises of three to four days, packed with a great variety of technical events, ranging from the intensely involving field of robotics and aeromodelling to just-for-fun competitions like foxhunt. This year saw the introduction of Wild-soccer, an event where the robots not only play against each other to score goals, but are also capable of annihilating each other. Tremor saw some impressive designs of infrastructure that could survive the deadllest of earthquakes. Various article writing, Group discussions and quiz competitions challenged our knowledge about the state-of-the-art in respective fields. Students not only tried their hands at robot navigation and embedded designs, but also simulated flight of aircrafts and later took part in the test flights of the models they had built. Events like Rube Goldberg and Gearloose made work fun, as the teams figured out ever impressive ways of putting junk to use. Workshops like ethical hacking and lecture on scientoonics offered some respite from the intense competition. Among others, some competitions tried to address real time problems being faced by the campus community like spamming of mailboxes.

TECHKRITI

Techkriti is the annual technology and entrepreneurship event of IIT Kanpur. With a strong and highly innovative team of both undergrads and post grads, the festival has become tantamount to a four day long technical and entrepreneurial marathon. Competitions at Techkriti are organized with the sole aim of promoting Technical expertise and business spirit amongst the students and to give them an overview of the “practical” world ahead. Techkriti 2011 will prove to be an epitome in the level of events conducted at IIT Kanpur. Various competitions being organized are Wild Soccer Championship (India’s first intercollegiate robosoccer competition), Cruise Control (it would also be the first time in India that plane of 70cc engine capacity would be flown over at the airstrip by IIT Kanpur students themselves), Endeavour (the open hardware and open software contest), BattleField (the premier case study competition), IORC (the biggest Rubik’s cubic contest in India and the first World Cubing Association affiliated event in the country), IOPC (the only student conducted programming event in India to witness truly international participation), IDEAS (the premier business plan competition), Tremor (the anti-earthquake design challenge), Episteme (quizzing section of Techkriti) and Junkyard Wars (in which the participants face the challenge of making a battle tank out of junk).

Another appealing aspect of Techkriti is the Talks and Exhibition section that are held with the commitment of giving the student community a nibble of personalities who have attained zenith in their fields. This year, Techkriti will be graced by the presence of Dr. Vladimir Voevodsky, Fields Medallist 2002, Dr. Michel Virlogeux, Designer of World’s Tallest Bridge Milau Viaduct, Bruce Melnick, Former NASA Astronaut, Dr. Sidney Altman, Nobel Laureate in Chemistry, Dr. Michael Gratzel, Millennium Technology Prize Winner among many other. There will also be many eminent entrepreneurs like Dr. Ashish Gupta, Chairman of Helion Venture Capital, Mr. Sanjeev Bikhchandani, Founder of Naukri.com group of companies and many young innovators in the India Innovators Forum.

Techkriti also prides itself for a large number of flamboyant technical exhibits it has each year. This year would be exciting with exhibitions of the most cutting edge technologies like PR2, World’s most advanced personal robot, I-Point presenter, a next gen UI device from Henrich Hertz institute, Interactive robots from Metal-Mate India, Grassroot technologies from National Innovation Foundation, Advanced 3D graphics from Sony among others.
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Sumeet Kumar

Gliding Club
Manish K Singh

HAM Club
Subhali Subhechha
Vishal Sachdev

Programming Club
Rahul Varma
Shitikanth
Utkarsh Lath

Robotics Club
Amol Pandey
Suhas Banshiwala
Vikas Mishra

Rubiks Cube Hobby Club
Pulkit Bansal
Sumit Sarkar

TECH CELL

Design and Media Cell
Aritra Saha
Hrishab Gupta
Kapil Garg

Public Relations Cell
Mayank Sharma
Shobhit Jain

Secretary Sci Tech Affairs
Punit Kumar Singhal
“Knowledge takes you from A to B, Imagination takes you everywhere”