

Department of
ELECTRONICS AND COMMUNICATION ENGINEERING

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e-SRUSHTI

TECHNICAL MAGAZINE

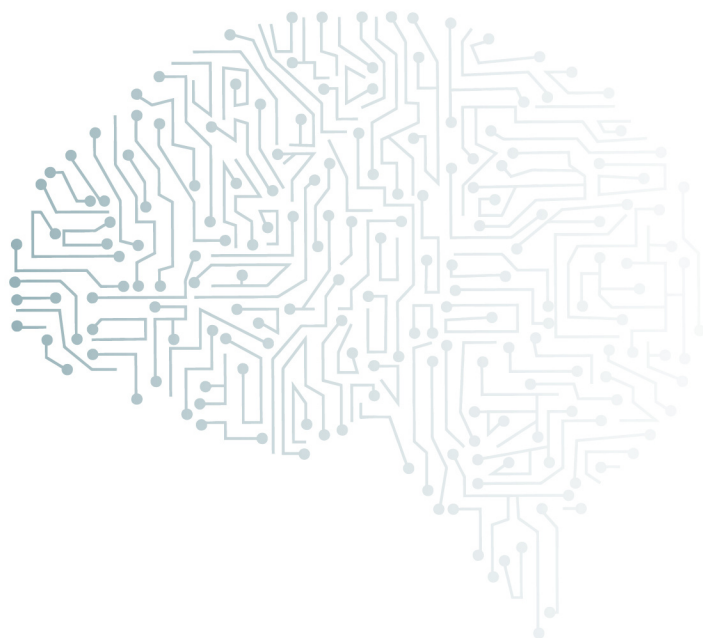
An Innovative Bucket...

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NARAYANA
ENGINEERING COLLEGE:: NELLORE



Vision of the Institute

To be one of the nation's premier Institutions for Technical and Management Education and a key contributor for technological and Socio-economic development of the nation.

Mission of the Institute

- To produce technically competent Engineers and Managers by maintaining high academic standards, world class infrastructure and core instructions.
- To enhance innovative skills and multi disciplinary approach of students through well experienced faculty and industry interactions.
- To inculcate global perspective and attitude of students to face real world challenges by developing leadership qualities, lifelong learning abilities and ethical values.

Vision of the Department

To produce technically competent and creative engineers who can cater to the industry and societal requirements in the field of Electronics & Communication Engineering.

Mission of the Department

- To impart quality engineering education to students to enhance ability to pursue knowledge by providing core competency and state of the art infrastructure.
- To provide industry oriented learning for empowering and facilitating the learner through industry institute interaction and leadership qualities.
- To promote participation in research and extension activities for addressing the social needs by providing value based education along with life-long learning abilities.

Program Educational Objectives (PEOs)

PEO_1: Attain professional excellence or gain higher degree to face challenges posed by industry and society.

PEO_2: Address complex problems in a responsive and innovative manner.

PEO_3: Gain reputation by functioning effectively to address social and ethical responsibilities.

Program Specific Outcomes (PSOs)

PSO_1: Domain Specific Knowledge: Implement electronic systems related to Electronics Devices & Circuits, VLSI, Signal processing, Microcomputers, Embedded and Communication Systems to fulfill the solutions to real world challenges

PSO_2: Hardware Product Development: Apply the software and hardware tools in Analog and Digital Electronic circuit design to address complex Electronics and Communication engineering problems.

Program outcomes(POs)

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- 6. The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- 8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROFESSOR DESK



The Department of Electronics and Communication Engineering has always been the gem of the Narayana Engineering College, Nellore.

The perennial zeal of the Department has never left the achievements stagnant. The Department not only gives students the exposure to the regular engineering curriculum but also to the aspirations of today's corporate world, that inculcating professional aptitude in them. The dedication of the faculty members has strengthened the learning process ensuring an environment of collaboration, experimentation, imagination, and creativity. It is such a prodigious delight in watching the students cutting edge in technical exploration, enhancing their analytical skills and brushing themselves up for the rapidly changing sector, and establishing themselves as entrepreneurs and engineers.

The Department has always reached new heights and I am looking forward to more wonders and achievements, I wish the very best to the Department of ECE for the launch of the E-SRUSHTI, the official technical magazine of the Department. The magazine beautifully provides an overview of research activities and the other fields explored by our students

Dr. M. Chandra Mohan Reddy

**Professor,
Dept. of ECE.**

Snake Robot

It is a name given to a ROBOT which looks like snake in appearance and also move like it. Snakebot or snakeroot is a different type of DRONE. Snakes can coil, elongate and adjust their shape to fit into a variety of spaces. The robot follows the principle called as a "MASTER-SLAVE PRINCIPLE" where the head is a master and controls all other modules.

SNAKES are modular in nature i.e., the robot is made up of independent parts (or) modules which are connected to each other and the controlling head through links (imagine this like a train, where the cars are connected to the engine through links). By alternating their movements, snakes are able to tackle different terrains and inclinations effectively. It would be highly deployable if we could imitate such movements and flexibility to our robots. The arrays of functionalities are boundary less.



SNAKE ROBOT

There are two qualities that all snakebots possess.

1. Their small cross-section to length ratio allows them to move into and maneuver through, tight spaces.
2. Their ability to change the shape of their body allows them to perform a wide range of behaviors, such as climbing stairs or tree trunks. Additionally, many snake robots are constructed by chaining together a number of independent links. This redundancy makes them resistant to failure, because they can continue to operate even if parts of their body are destroyed. Properties such as high terrain ability, redundancy, and the possibility of complete

The Israel Army uses Snakebots in assault and for detecting landmines and buried explosives. This is interesting as they have used Taser guns with

these bots so that the rioter animal can be subdued in a non-fatal manner. Some snakebots snakebots possess the ability to dive are being sent to underwater for exploration. Snakebots can go under debris with required sensors and help track survivors who are in dire need rescue.



Snakebot Exploration in Fields

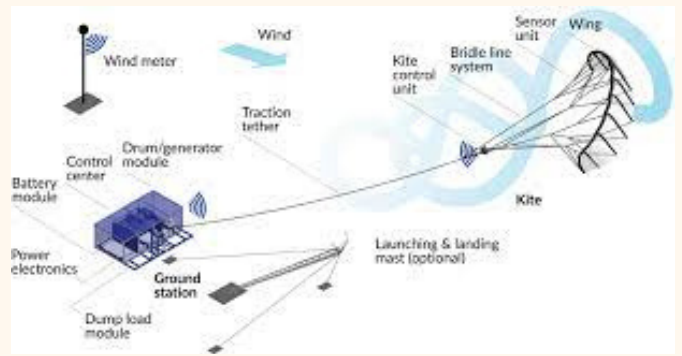
**K. PAVITHRA, III
E.C.E**

Energy Kites

Now a days, there is abundant usage of electricity. The problems posed by electric energy generation from fossil sources include high costs due to large demand and limited resources, pollution and CO2 production, and the geopolitics of producer countries. These problems can be overcome by alternative sources that are renewable, cheap, easily available, and sustainable. However, current renewable technologies have limitations. So, many of them tried to find new methods of power generation using renewable resources.

Out of all innovative ideas one major idea that's gaining great attention is Airborne wind energy. Replacing, the traditional structure of wind turbine by Kites tethered to ground is the main idea behind Airborne wind energy.

Energy Kites is a revolutionary technique of power generation. With growing technological innovations & carbon footprints, energy at a cheaper rate with negligible greenhouse effect have become vital. It had become a leading energy source for many companies.



AIR BORNE WIND ENERGY TECHNOLOGY

**G. CHARAN TEJA REDDY,
III E.C.E**

Automatic Railway Gate Control

Automatic Railway Gate Control System is implemented to prevent accidents of the Traction System at Railway crossing levels. In general, a Railway gate is normally operated by a gate keeper as he receives the information. This is cheapest mode of transportation all over the world, therefore accidents are bound to happen due to carelessness. Therefore, if we implement automatic Railway control system may controls accident levels.



AUTOMATIC GATE CONTROL SYSTEM

Automatic gate control system can be implemented using different Technologies such as GSM, Bluetooth and android. In this describes two GSM Technologies. Railway level-Crossing gate operation remotely by an android device. This system uses android application device for opening and closing the level crossing gate, remotely. This can be operated by smart phone or Tablet which based on touch screen operation. A Bluetooth device attached to control circuit at the receiver side, this receives these signals and sends them to the microcontroller that

helps to operate including a buzzer for alerting the persons at the gate. so it can help easily to open or close.

Railway level-crossing gate control through GSM which similar to GCS, but implemented by using GSM Technology. The system has modern interfaced with a control system. When a driver sends an SMS 'open' to GSM modern and gate can be automatically opens. If 'close' gate can be closed helps by micro controller



LEVEL-CROSSING GATE CONTROL SYSTEM USING GSM

**K. RAMYA SREE,
III E.C.E**

Water Jet Machine

Generally, we use water for our daily life usage. You can also use the water to cut the objects like camera or mobile phones and heavy metals. With the help of water jets we can do all the above works easily.

Probably, these water jets are introduced in 1970's in United States. Firstly, these are used for cleaning purposes only. Later, it is evolved and merely used in industries. Water jet machining is a mechanical energy based non-traditional machining process. It involves the use of high velocity water jet to smoothly cut a soft work piece. During the process water kinetic energy is converted into pressure energy which induces a stress on work piece.

The components of water jet are pump, intensifier, accumulator, control valve, flow regulator, nozzle, mixing tube, catchers.

Applications:

- In construction industry
- In printed circuit board design
- Wire stripping
- Food preparation
- Wood cutting
- River removal
- Paint removal

As of my conclusion, water jets are very useful in the industries but due to lack of knowledge and also the fear of taking risks these water jets are not yet implemented in many of the industries. If they do so it will be a revolution.

**N. LEELA KUMARI,
IV E.C.E**

Technologies Taking Communications To The Absolute Next Level

Technology in communications once is a necessity and now is a part of our life. speaking to distance, states, countries and galaxies to our amaze. Connecting people, computers, environment, machines now even objects! time has taken us so far in advancement. Here are some technologies, DefyIng Disabilities - R-T Communication system for the disabled: Communication system for the deaf and mute that helps convert sign language into text and equipped to speech. The system consists of a gesture recognizer hand glove which converts gestures to electrical signals using flex sensors these signals are then processed using Arduino micro controller and a python based backend for the text to speech conversion. This invention is a clear examples of humans turning creator.



HUMANOID ROBOT

RISE OF HUMANOID BOTS - The Artificial intelligence:

objects ,electronics ,machines..communicating to them robots being no more automated working on their own intelligence sounds impossible , complex but were made possible in the span.

IBM WATSON: IBM supercomputer that combines artificial intelligence (AI) and sophisticated analytical software for optimal performance as a “question answering” machine. The Watson supercomputer processes at a rate of 80 teraflops .

To replicate a high-functioning human’s ability to answer questions, Watson accesses 90 servers with a combined data store of over 200 million pages of information, which it processes against six million logic rules. The device and its data are self-contained in a space that could accommodate 10 refrigerators.

SOPHIA THE ROBOT: Sophia is a humanoid robot which is the first ever robot to gain a citizenship. Sophia uses artificial intelligence, visual data processing and facial recognition. Sophia also imitates human gestures and facial expressions and is able to make conversations. Sophia replicates era of evolution.



HUMANOID ROBOT WITH AI

**E. CHARITHA,
IV E.C.E**

Ever Widening Circles Of VR in Healthcare

What if your surgeon told you that they’ve stood inside of a human heart? Your first instinct would probably be to tell them that they’re crazy. That they’re far too tall to be able to be inside of a human heart, that’s just insane. But then you’ll remember that technology is a thing. And that people are applying it in some really fascinating ways these days.

Here’s where the virtual reality comes in... Next thing you know they’re bringing in a headset. They put it over your eyes and suddenly you’re staring at a human heart. The surgeon then shows you the issue, what they’ll be doing to fix it, and why. You’ll be able to walk through, first hand, what is and what will be happening to you or a loved one thanks to the virtual technology How would that make you feel?

Really amazing feel that you might have never and ever experienced. It’s not only one of our most crucial organs, but also one of the most

Aside from keeping that beat for years, even the process the heart goes through to form in utero leaves a lot of space for abnormality, and it happens a lot — every year about 40,000 people are born with congenital heart defects (CHDs) in the United States But it’s a pretty difficult organ to study in action, considering the person needs to be on the table with their chest splayed open...

which involves lot of procedure to be undergone by surgeons and risk for the individual operated upon. Now without splaying the organs we can easily know the condition of heart and other vital organs of the body. And how do you go about explaining what’s happening to the family members?

How do the parents of the children born with heart defects even begin to try to understand an organ that doctors have spent years studying? Well, what about an interactive visual? It seems like the perfect home for our friend, virtual reality (VR). Pediatric cardiologists are utilizing VR at Lucile Packard Children’s Hospital Stanford to make it easier to communicate and understand what’s happening with these complicated CHDs., and the true benefits of bringing this technology into healthcare!



VR IN HEALTHCARE

**A. DIVYA,
IV E.C.E**

The Impact of using Robotic Technology



INDUSTRIAL ROBOT

HUMANOID ROBOTS: A humanoid robot is a robot with its overall appearance based on that of the human body. It is an autonomous robot because it can adapt to changes in its environment or itself and continue to reach its goal. These humanoid robots are currently being used as a research tool. The research in humanoid robotic technology is rising and will soon change the world. These can perform certain tasks on their own through voice commands from a human being.



MILITARY ROBOT



HUMANOID ROBOT

**V. SAI CHARITHA,
III E.C.E**

Activity Tracker

It is an advanced activity tracker housed in a classic watch designed for simplicity; it has no screen but shows your activity directly on the dial with its third hand. Withings Move seamlessly tracks walking, running, sleeping, swimming and much more, plus features connected GPS to map your path.

Now a day's Robotic technology is increasing at a fast rate, providing us with new technology that can assist automobile assembly and many other tasks. Robotic technology has changed the world around us and is continuing to impact the way we do things. The use of robots continues to change numerous aspects of our everyday life, such as health care, education and job satisfaction. Robots are growing to be a major part of the world economy. They help many ways to make our daily life easier and assist in producing more products. The use of Robotic technology has made an intermediate impact on the world in several ways. There are many types of robots in our day to day life such as,

BODY INDUSTRIAL ROBOTS: First the industrial robot has help changed the industrial workplace. The industrial robots have enhanced the product quality and improved industrial operations. These robots, termed "industrial robots", were found almost exclusively in auto mobile manufacturing plants 20 years ago. But now these industrial robots are used in laboratories, research and development facilities... etc., manufacturing plants 20 years ago. But now these industrial robots are used in laboratories, research and development facilities...etc.

MILITARY ROBOTS: Generally, military robots come in different shapes and sizes according to the military purposes. These military robots are used for bomb disposal, search and rescue missions and attack operations. These are also equipped with a camera to provide soldiers with the view of the battlefield and dangerous obstacles. These part in combat operations throughout the world.

MEDICAL ROBOTS: The medical robot is helping to change the medical field, these are used to train surgeons, assist in difficult and precise surgical procedures and to assist patients in recovery.

These robots are equipped with a computer-integrated technology that contains a complex of programmed languages, controllers and advanced sensors. Although robots cannot actually check patients, they, give doctors the ability to have social interaction with each other by using a screen attached to the medical robot.

It syncs with the free Health Mate app so you can view your trends and improve over time. Without any charging we can use up to 18 months so that you can enjoy and go the extra mile for walk. It is a water resistant up to 50 meters and fully customizable. By taking it to bed it will automatically track light and deep sleep cycles, duration, quality of sleep via the sleep score. The silent alarm feature is ready to wake you with gentle vibration.



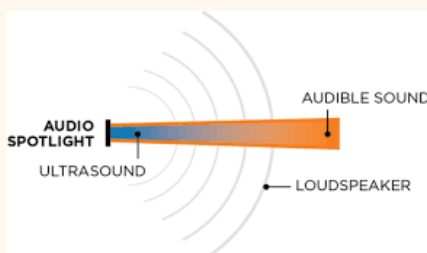
ACTIVITY TRACKER BAND

**K. DIVYA LAKSHMI,
IV E.C.E**

Audio Spot lighting

Audio spot lighting is a very recent technology that creates focused beams of sound similar to light beams coming out of a flashlight. By 'shining' sound to one location, specific listeners can be targeted with sound without others nearby hearing it. It uses a combination of non-linear acoustics and some fancy mathematics for its working. But it is real and is fine to knock the socks of any conventional loud speaker.

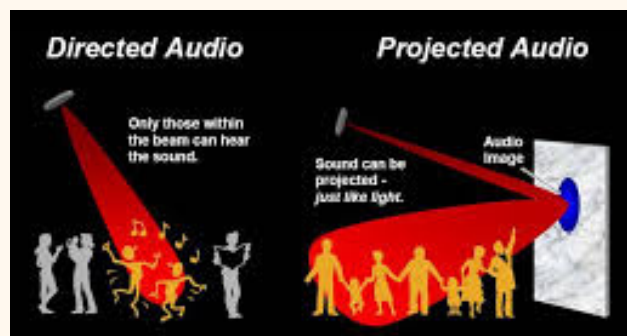
This acoustic device comprises a speaker that fires inaudible ultrasound pulses with very small wavelength which act in a manner very similar to that of a narrow column. The ultra sound beam acts as an airborne speaker and as the air gradual distortion takes place in a predictable way due to the property of non-linearity of air. .



AUDIO SPOT LIGHTENING TECHNOLOGY

This gives rise to audible components that can be accurately predicted and precisely controlled. Joseph Pompei's Holosonic Research Labs invented the Audio Spotlight that is made of a sound processor, an amplifier and the transducer. The American Technology Corporation developed the Hyper Sonic Sound-based Directed Audio Sound System.

Both use ultrasound based solutions to beam sound into a focused beam. Audio spotlight can be either directed at a particular listener or to a point where it is reflected.



USE OF AUDIO SPOT LIGHT

**V. SAI CHARITHA,
III E.C.E**

Geriatric Care System Using Electronically Controlled Air Jacket

The electronic Jacket is an acceleration based system which detects the fall event by measuring the applied acceleration along the three axes. As acceleration is the most reliable information that can be used for detecting a fall, while other kinematic data, such as angular velocity, is less relevant. In addition to automated fall detection mechanism, the system also employs various novel techniques for mitigating the hazardous impact of a fall event. This product is designed as wearable jacket which consists of pressurized plastic air bags storing compressed air and a Solenoidal valve , which helps in mitigating the impact of a fall. Additionally, false detection switches are employed to overcome the issue of false trigger alarms caused by various day to day activities.

Advantages of E-Jacket for Fall Detection:

- The activity of the user is continuously monitored using an entity acceleration, which, when crosses a threshold value indicates that fall has been detected.
- The module also includes pressurized plastic bags which are filled with air pumped with the help of a solenoid valve arrangement. This arrangement helps in mitigating the harmful impact of fall and fall-related event.
- The system consists of a GPS module; it provides an accurate location of the user using which the user's location can be easily found.
- After the fall event, a request for help is sent to the caregivers who can provide the required medical assistance in time.
- The module is designed in the form of a wearable jacket which is best suited for both indoor and outdoor events.

Implementation of e-Jacket for fall detection is based on the principle of activity monitoring. Initially, the user will be wearing this system around his waist. The Electronic Jacket consists of a MEMS accelerometer (sensor) which keeps on monitoring the user's activity. Whenever the person falls down, the acceleration due to the mechanical movement of the body becomes greater than a given value. This change in acceleration is sensed by a sensor module. This sensor module will be continuously monitored by a Microcontroller.

During the event of a fall, the acceleration at the center of gravity of the user's body crosses a previously calibrated threshold value which in turn triggers the Microcontroller. The Microcontroller activates the solenoid valve and the pressurized plastic bags are filled with air. The air field pressurized plastic bags helps in reducing the impact of the fall and prevents any major injuries which could lead to serious health implications.

Additionally, the Microcontroller also triggers the GPS Module, which fetches the location of the user and sends it to the Microcontroller. The Microcontroller in turn provides appropriate control signals for the GSM Module to send a message to the doctor for the immediate medical assistance.

Process Flow:

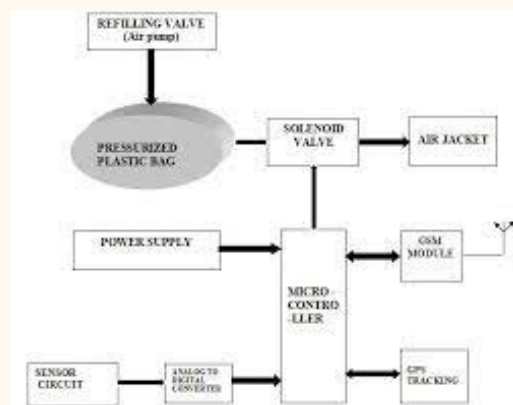
The process of fall detection is comprised of the following four stages of operation.

- a) Input stage – MEMS Accelerometer
- b) Processing stage – Microcontroller
- c) Trigger stage – Arrangement of pressurized plastic bags, miniaturized air pumps, solenoid valve.
- d) Communication Stage – GSM Module and GPS Module.

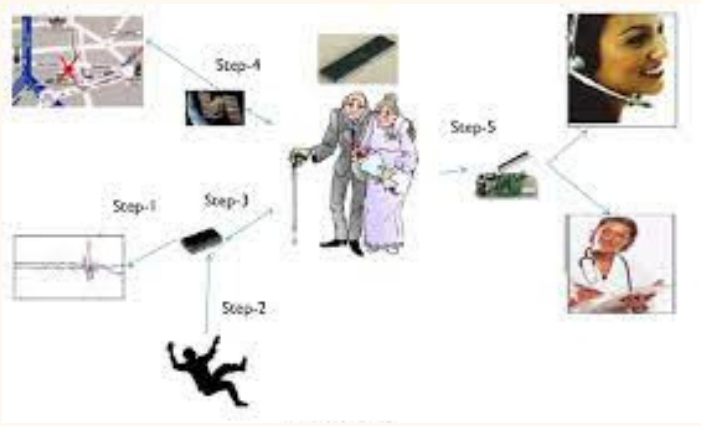
OPERATION OF THE MOTE:

The Smart Dust mote is run by a microcontroller that not only determines the tasks performed by the mote, but controls power to the various components of the system to conserve energy. Periodically the microcontroller gets a reading from one of the sensors, which measure one of a number of physical or chemical stimuli such as temperature, ambient light, vibration, acceleration, or air pressure, processes the data, and stores it in memory. It also occasionally turns on the optical receiver to see if anyone is trying to communicate with it. This communication may include new programs or messages from other motes. In response to a message or upon its own initiative the microcontroller will use the corner cube retro reflector or laser to transmit sensor data or a message to a base station or another mote.

The primary constraint in the design of the Smart Dust motes is volume, which in turn puts a severe constraint on energy since we do not have much room for batteries or large solar cells. Thus, the motes must operate efficiently and conserve energy whenever possible. Most of the time, the majority of the mote is powered off with only a clock and a few timers running. When a timer expires, it powers up a part of the mote to carry out a job, then powers off.



BLOCK DIAGRAM OF MOTE



ELECTRONICALLY CONTROLLED AIR JACKET

**V. SAI CHARITHA,
III E.C.E**

Electronics Cross Words

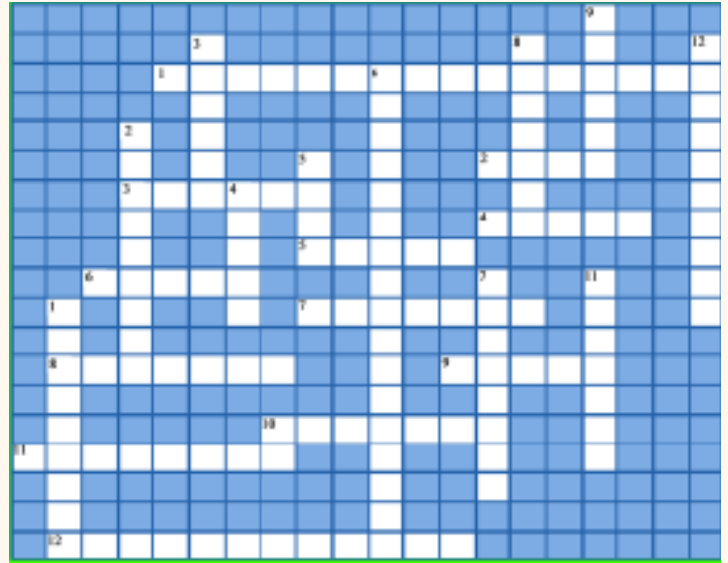
Across:

- Two resistors connected together, across a power supply (9, 7)
- Process used to remove unwanted copper from a PCB (4)
- Colour band used to indicate the number 7 (6)
- Colour band used to indicate the number 0 (5)
- Connects the components together on a PCB (5)
- A component which allows current to flow only in one direction (5)

Down:

- Shape of the schematic symbol for a resistor (9)
- Stores the charge (9)
- Electrically joints components to a PCB (6)
- Energy that allows the electronics to work (5)
- Check the board works, after construction (4)
- A chip / part with two rows of pins (10, 7)
- Component with coloured bands to determine its value (8)
- Something that can only be true / false, 0 or 1 (7)
- Used to turn things on and off (6)
- Letters used to mark commercial electronics sold in Europe (2)

- Measured across components such as batteries (7)
- A component that acts like an electronic switch (10)
- Makes a sound (7)
- A collection of components, connected together (7)
- The L in LED (5)
- Flows through a circuit (7)
- Electronics that works with real voltages (9)
- Type of capacitor, which is polarised (12)



Electronics Quiz

- What kind of electronic magnetic waves does the typical TV remote use?
 - Radio waves
 - Infrared Radiation
 - Ultraviolet
 - Ultrasound
- Which of the following electronic components is not headquartered in Japan?
 - Toshiba corporation
 - Sony corporation
 - Samsung electronics
 - Panasonic corporation
- Which material is computer's processor made of?
 - Single crystal ruby
 - Single crystal silicon
 - Silicon polycrystal
 - Pyrite crystal
- Which device converts an acoustic wave into an electrical signal?
 - Headphones
 - Loudspeaker
 - Microphone
 - Amplifier

5. John Barden, Walter Houser Brattain and William Bradford Shockley received the nobel proze in physics in 1956 for the invention of _____.

7. Which resistive component is designed to be temperature sensitive?

- (a) . Thermistor (b). Rheostat (c). Potentiometer (d). Photoconductive ce(a). Single crystal ruby (b). Sinlge crystal silicon (c). Silicon polycrystal (d). Pyrite crystal

6. What may happen to a lead battery when overcharged?

- (a). Acid leak (b). Polarization switch (c). Explosion (d). Sulfurization

Match The Following

List I (Laws of Boolean algebra)

List II (Relation algebra)

- | | |
|---------------------|-------------------------|
| A. Distributive law | 1. $x + x = x$ |
| B. DeMorgans law | 2. $x(y + z) = xy + xz$ |
| C. Idempotent law | 3. $(x) = x$ |
| D. Involution law | 4. $(x + y) = xy$ |

Riddles

1. What word when written in capital letters are the same forwards backwards and upside down?
2. There is only one ten letter word in the english language which can be typed using only the top row of the keys on a type writer(or keyboard) what is it?
3. The day before yesterday I was 25 and the next year I will be 28. This is true only one day in a ear. What day is my birthday?
4. What can you break but not touch?
5. Say my name and I disappears what am I?
6. What kind of pet always stays on the floor?
7. What is that when you take away the whole, you still have some left?

New Space Time 4-D Clock

Scientists have proposed to build the first ever 4D space-time crystal clock that they claim will keep accMrate time forever, even after the heat-death of the universe .This is the “wow” factor behind a device known as a “space-time crystal,” a four- dimensional crystal that has periodic structure in time as well as space. Researcher Xiang Zhang from Berkeley Lab’s Materials Sciences Division, who led this research, and his group, have come up with an experimental design to build a Crystal that is dls Create both in space and time- a space-



4-D CLOCK

tiM9 Crystal .However, there are also practical and important scientific reasons for constructing a space-time crystal. With such a 4-D crystal, scientists would have a new and more effective means to study how complex physical properties and behaviour emerge from the collective interactions of large numbers of individual particles. “A space-time crystal could also be used to study phenomena in the quantum world, such as entanglement, in which an action on one particle impacts another particle even if the two particles are separated by vast distances”, scientists said. Scientists from the US Department of Energy (DOE)’s Lawrence Berkeley National Laboratory has proposed the experimental design of a space-time crystal based on an electric-field ion trap and the Coulomb repulsion of particles that carry the same electrical charge. The concept of a crystal that has discrete order in time was proposed earlier this year by Frank Wilczek, the Nobel-prize winning physicist at the Massachusetts Institute of Technology. While Wilczek mathematically proved that a time crystal can exist, how to physically realize such a time crystal was unclear.



2-D CLOCK

**C. ASRITHA,
II E.C.E**

Bubble Power

Sonofusion is technically known as acoustic inertial confinement fusion. In this we have a bubble cluster (rather than a single bubble) is significant since when the bubble cluster implodes the pressure within the bubble Cluster may be greatly intensified. The centre of the gas bubble cluster shows a typical pressure distribution during the bubble cluster implosion process. It can be seen that, due to converging shock waves within the bubble cluster, there can be significant pressure intensification in the interior of the bubble cluster.

This large local liquid pressure ($P > 1000$ bar) will strongly compress the interior bubbles with in the cluster, leading to conditions suitable for thermonuclear fusion. More over during the expansion phase of the bubble cluster dynamics, coalescence of some of interior bubbles is expected, and this will lead to the implosion of fairly large interior bubbles which produce more energetic implosions. The apparatus consists of a cylindrical Pyrex glass flask 100 m.m. in high and 65m.m.in diameter.

A lead-zirconate-titanate Ceramic piezoelectric crystal in the form of a ring is attached to the flask's outer surface. The piezoelectric ring works like the loud speakers in a sonoluminescence experiment, although it Creates mUch stronger pressure waves. When a positive voltage is applied

to the piezoelectric ring, it contracts; when the voltage is removed, it expands to its original size. The flask is then filled with COMmerCially available deuterated acetone (C_3D_6O), in which 99.9 percent of the hydrogen atoms in the acetone molecules are deuterium (this isotope of hydrogen has one proton and one neutron in its nucleus). The main reason to choose deuterated acetone is that atoms of deuterium can undergo fusion much more easily than ordinary hydrogen atoms. Also the deuterated fluid can withstand significant tension (stretching) without forming unwanted bubbles. The substance is also relatively cheap, easy to work with, and not particularly hazardous.



BUBBLE POWER

**D. JYOTHSNA,
II E.C.E**



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