D Y PATIL
COLLEGE of
ENGINEERING & TECHNOLOGY
KASABA BAWADA, KOLHAPUR
(An Autonomous Institute)

ELECTRONICS AND TELECOMMUNICATION DEPARTMENT

TECHNICAL NEWSLETTER

SPARK 2K21

INDEX

EDITORIAL BOARD

STUDENT COORDINATORS

•Yash Kavathekar (Final year)
•Sakshi Ghatge (Final year)
•JenilBhoot (T Y BTECH)
•Sakshi Pawar (T Y BTECH)

MICROCONTROLLER (MCU)

- A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.
- Sometimes referred to as an embedded controller or microcontroller unit (MCU), microcontrollers are found in vehicles, robots, office machines, medical devices, mobile radio transceivers, vending machines and home appliances, among other devices. They are essentially simple miniature personal computers (PCs) designed to control small features of a larger component, without a complex front-end operating system (OS).

How does controller work?

- A microcontroller is embedded inside of a system to control a singular function in a device. It does this by interpreting data it receives from its I/O peripherals using its central processor. The temporary information that the microcontroller receives is stored in its data memory, where the processor accesses it and uses instructions stored in its program memory to decipher and apply the incoming data. It then uses its I/O peripherals to communicate and enact the appropriate action.
- Microcontrollers are used in a wide array of systems and devices. Devices often utilize multiple microcontrollers that work together within the device to handle their respective tasks.
- For example, a car might have many microcontrollers that control various individual systems within, such as the anti-lock braking system, traction control, fuel injection or suspension control. All the microcontrollers communicate with each other to inform the correct actions. Some might communicate with a more complex central computer within the car, and others might only communicate with other microcontrollers. They send and receive data using their I/O peripherals and process that data to perform their designated tasks.

What are the elements of a microcontroller?

- The core elements of a microcontroller are:
- The processor (CPU) -- A processor can be thought of as the brain of the device. It processes and responds to various instructions that direct the microcontroller's function. This involves performing basic arithmetic, logic and I/O operations. It also performs data transfer operations, which communicate commands to other components in the larger embedded system.

- Memory -- A microcontroller's memory is used to store the data that the processor receives and uses to respond to instructions that it's been programmed to carry out. A microcontroller has two main memory types: Programming memory and Data memory

- I/O peripherals -- The input and output devices are the interface for the processor to the outside world. The input ports receive information and send it to the processor in the form of binary data. The processor receives that data and sends the necessary instructions to output devices that execute tasks external to the microcontroller.

- Other supporting elements of a microcontroller include: 1)Analog to Digital Converter (ADC) 2) Digital to Analog Converter (DAC) 3) System bus 4) Serial port

Microcontroller features:

- A microcontroller's processor will vary by application. Options range from the simple 4-bit, 8-bit or 16-bit processors to more complex 32-bit or 64-bit processors. Microcontrollers can use volatile memory types such as random access memory (RAM) and non-volatile memory types -- this includes flash memory, erasable programmable read-only memory (EPROM) and electrically erasable programmable read-only memory (EEPROM).
- Generally, microcontrollers are designed to be readily usable without additional computing components because they are designed with sufficient onboard memory as well as offering pins for general I/O operations, so they can directly interface with sensors and other components.
- Microcontroller architecture can be based on the Harvard architecture or von Neumann architecture, both offering different methods of exchanging data between the processor and memory. With a Harvard architecture, the data bus and instruction are separate, allowing for simultaneous transfers. With a Von Neumann architecture, one bus is used for both data and instructions.

Types of microcontrollers:-

- Common MCUs include the Intel MCS-51, often referred to as an 8051 microcontroller, which was first developed in 1985; the AVR microcontroller developed by Atmel in 1996; the programmable interface controller (PIC) from Microchip Technology; and various licensed Advanced RISC Machines (ARM) microcontrollers.
- A number of companies manufacture and sell microcontrollers, including NXP Semiconductors, Renesas Electronics, Silicon Labs and Texas Instruments.

Microcontroller applications:-

- Microcontrollers are used in multiple industries and applications, including in the home and enterprise, building automation, manufacturing, robotics, automotive, lighting, smart energy, industrial automation, communications and internet of things (iot) deployments.
- The simplest microcontrollers facilitate the operation of electromechanical systems found in everyday convenience items, such as ovens, refrigerators, toasters, mobile devices, key fobs, video game systems, televisions and lawn-watering systems. They are also common in office machines such as photocopiers, scanners, fax machines and printers, as well as smart meters, ATMs and security systems.

Choosing the right microcontroller:-

- Beyond cost, it is important to consider the maximum speed, amount of RAM or ROM, number or types of I/O pins on an MCU, as well as power consumption and constraints and development support. Be sure to ask questions such as:
- What hardware peripherals are required?
- Are external communications needed?
- What architecture should be used?
- What sort of community and resources are available for the microcontroller?
- What is the market availability of the microcontroller?

Written By:
Aditya Digambar Shinde
E&TC SY-BTECH

EEG SIGNAL MONITORING SYSTEM

What is EEG?

EEG i.e. Electroencephalogram is One of the safest and most commonly used technologies to study the human brain. The human brain is the most intricate, complex and fascinating elements of the universe. The brain cells communicate with each other via electrical impulses. EEG is a technique to measure this electrical activity from scalp using electrodes and the further analyse it to determine that particular activity.EEG has become the technology with the largest number of published scientific research studies on the brain. The world of neuroscience changed dramatically with the introduction of the first human EEG recording in 1924.

Why EEG?

EEG is one of the safest, low cost and efficient method in neural imaging as compared to other methods like MRI, fMRI, MEG etc. EEG signal are easy to record, process and analyse. EEG can determine changes in brain activity that might be useful in diagnosing brain disorders, especially epilepsy or another seizure related disorder. Apart from this clinical uses of EEG, The non-clinical uses include neuroscience, psycho-physiological, Brain Computer Interface (BCI) and other researches.

BCI- Brain Computer Interface:

A relatively new but emergent field for EEG is brain-computer interfaces. Today, we know in much more detail which brain areas are active when we perceive stimuli, when we prepare and execute bodily movements, or when we learn and memorize things. This gives rise to very powerful and targeted EEG applications to control devices using brain activity. This can, for instance, help paralyzed patients steer their wheelchairs or move a cursor on a screen, BCI technology is also used for military scenarios where soldiers are equipped with an EEG based system, allowing them to move, lift and carry very heavy items simply based on brain activity. Even in gaming EEG can be used to control the console. And also in vehicles to control different functions or to detect the sleepiness of driver and give alert accordingly

Our Research:

We have designed a system to measure the EEG signal and analyse the cognitive behaviour of the brain. Our designed system indicates the concentration level of human brain using EEG signals. It is low cost, high performance and easy to use as compared to other systems. It is non-invasive in nature i.e. we just have to place electrode on the scalp instead of inserting inside the skin layer, this is the major advantage of our system. The BCI devices in the market make use of 20-30 electrodes to measure the EEG signal, we have designed our hardware such that it works only on 2 electrodes, this helps in reducing the time and precision required to place the electrodes.

PROJECT OVERVIEW:

Our project can be classified into 3 main parts which include design of hardware, Signal processing and analysing and displaying the results on the GUI screen.

We have designed 2 electrode headset to measure the signal from scalp. The EEG signal is of very low voltage and affected by noise or artifacts such as muscle movement, eye blink, heartbeat etc. so to get desired signal we have designed an Analog front end (AFE) circuit which is very precise and accurate. It consists of an instrumentation amplifier which can amplify the signal 1000 times and it can also reduce the radio frequency interference affecting the EEG signal. The AFE consists of 3 filtering circuits which are capable for reducing all the artifacts and noises. We have recorded the signal in laptop using MATLAB software. In MATLAB we have applied advance signal processing algorithms to EEG signal. To analyse the signal we need to extract feature from the signal, we have done this using two methods discrete wavelet transform and Power spectral density. EEG signal is classified into 5 frequency bands called Delta, Theta, Alpha, Beta and Gamma. This bands carries different type of EEG data, our concentration signal lies in alpha and beta band. We have collected EEG samples of different students and trained that dataset using machine learning algorithms. To classify the EEG signal we have used Support Vector Machine classifier. We have designed an application to run all this programs. Using this program we determine the concentration level and display it using an indicator as show in figure below.

Further we are going to implement this system to detect stress, focus, alertness drowsiness, anxiety etc.

This project is sponsored by Indiam Technologies, Kolhapur.

Made under Guidance of
Dr. Mrs. S. V. Sankpal
Yash Kavathekar
Sakshi Ghatge

FOUR LEGGED WALKING ROBOT

INTRODUCTION:

Four legged walking robot: -The walking robot is basically made up of cardboard structure as a replica for one of the real insect robot. It has four legs like an insect, which has such a movement that robot can move forward and backward.

The legs of the robot are controlled by motion of the servo motor. The microcontroller used for programming of the servo motor is Arduino Uno SMD R3. Arduino Software v1.8.7 is used for programming the microcontroller.

ABOUT ARDUINO UNO Micro-Controller:-

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.

The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts.

- **General Pin functions:-**

1. LED: There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
2. VIN: The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
3. 5V: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
4. 3V3: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
5. GND: Ground pins.
6. **IOREF:** This pin on the Arduino / Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.
7. Reset: Typically used to add a reset button to shields which block the one on the board.

In addition, some pins have specialized functions:

8. Serial: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

COMPONENTS:

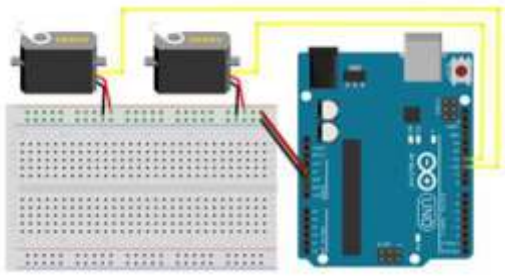
SR. NO.	COMPONENTS	SPECIFICATIONS	QUANTITY
1.	ARDUINO Microcontroller	ARDUINO UNO	1
2.	SERVO MOTOR	-	2
3.	JUMPER WIRE	MALE & FEMALE	\8
4.	USB CABLE	-	1
5.	*WALKING MECHANISM*	-	1
6.	*Arduino Software*	Version 1.8.7	1

CONSTRUCTION:

Walking mechanism is controlled by Arduino UNO microcontroller.In this project I have designed a walking mechanism with help of wooden sticks. The servo motor is mounted on the walking mechanism which is connected to the robot's legs.

Orange wire (PWM) of first servo is connected to pin no. 11 and the second servo is connected to pin no. 10 of arduino Uno. Now Brown wire (GND) of both servo is connected to ground. Then remaining red wire (+5v) of both servo is connected to 5v supply port of arduino Uno. Then USB data cable is connected to PC from which we give program to arduino Uno.

CIRCUIT DIAGRAM:



WORKING:

When the Arduino Uno microcontroller is connected to the programming device (computer) with help of special USB cable the program is compiled and stored into the microcontroller.

Front and back servo motors are arranged such that front goes forward 30 degree the back goes backward 30 degree after 300 micro second. This loop goes on which results in walking motion of the robot like an insect..

WRITTEN BY:

Nikhil Gholkar
SY BTECH ENTC

F-22 RAPTOR

•What is F-22 Raptor?

The Lockheed Martin F-22 Raptor is a single-seat, twin-engine, all weather stealth tactical fighter aircraft developed exclusively for the United Stated Air Force (USAF). The result of USAF's Advanced Tactical Fighter (ATF) program, the aircraft was designed primarily as an air superiority fighter, but also has ground attack, electronic warfare, and signal intelligence capabilities.

The F-22 Raptor is a fifth-generation fighter that is considered as fourth generation in stealth aircraft technology by the USAF. It is the first operational aircraft to combine supercruise, superman euver ability, stealth, and sensor fusion in a single weapon platform. The f-22 has four empennage surfaces, retractable tricycle landing gear, and clipped delta wings with reverse trailing edge sweep and leading edge extensions running to the upper outboard corner of the inlets. Flight control surfaces include leading-edge flaps, flaperons, ailerons, rudders on the canted vertical stabilizers, and all-moving horizontal tails; for speed brake function, the ailerons deflect up, flaperons down, and rudders outwards to increase drag. The aircraft's dual Pratt and Whitney F119-PW100 augmented turbofan engines are closely spaced and incorporate pitch-axis thrust vectoring nozzles with a range of 20degrees. Each engine has maximum thrust in the 35,000 lbf (156 kN) class. The maximum speed without external stores is approx. Mach 1.8 at military power and greater than Mach 2 with afterburners. The use of internal weapons bays permits the aircraft to maintain comparatively higher performance over most other combat-configured fighters due to lack of parasitic drag from external stores. The F-22's aerodynamics, relaxed stability, and powerful thrust-vectoring engines give it excellent man euver ability and energy potential across its flight envelope. It has excellent angle of attack, capable of flying at trimmed angle of over 60degree while maintaining roll control and performing man euvers such as the J-turn. The flight control system has fully-authorised digital engine control and it is departure resistant and controllable thus, gives the pilot carefree handling.

*** Design and features of F-22 Raptor:**

1] length- 18.9 meters
2] height- 5.1 meters
3] wingspan- 13.6 meters
4] range- 1,600 nm
5] It can carry AIM-120A AMRAAM or external fuel tanks; has three internal weapon bays where the main weapons bay can carry six AMRAAM AIM-120C missiles or two AMRAAM and two 1,000lb GBU-32 joint direct attack munition.
6] The AN/APG-77 RADAR has been developed for F-22, this radar uses an active electronically scanned antenna array of 2,000 transmitter/receiver modules, which provides agility, low radar cross-section and wide bandwidth.

*** Reason of F-22 raptor for being most deadliest fighter plane:**

The two new weapons namely AIM-9X(air-to-air) missile and AIM 120-D which have been tested and developed years ago are a part of this plane. The AIM-9X can shoot farther and can reach a much larger targeting envelope for pilots. The AIM 120-D is designed for all weather day and night attacks; it is a 'Fire and Forget' missile with active transmit radar guidance. Many countries have considered this as the best jet fighter ever produced, due to its Synthetic Aperture Radar(SAR) technology, which uses the electromagnetic signals to calculate the contours, distance and characteristics of the ground below.

Article by-
Aarya Sandeep Jadhav
SY- E&TC