

ROBOTIC HUMANOID ARM DESIGNING AND PROTOTYPING FOR PHYSICALLY DISABLED PEOPLE

Submitted in partial fulfillment of the requirements for the award of

Bachelor of Engineering degree in Mechanical Engineering

By

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**DEPARTMENT OF MECHANICAL ENGINEERING SCHOOL OF
MECHANICAL ENGINEERING**

SATHYABAMA

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade "A" by NAAC

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MARCH 2021



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **ARUL KENNADY.J (37150018) ,SURENDHAR.M (37150187)** who carried out the project entitled **“ROBOTIC HUMANOID ARM DESIGNING AND PROTOTYPING FORPHYSICALLY DISABLED PEOPLE”** under our supervision from December 2020 toMarch 2021.

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We **ARUL KENNADY.J (37150018) ,SURENDHAR.M (37150187)** hereby declare that the Project Report entitled **“ROBOTIC HUMANOID ARM DESIGNING AND PROTOTYPING FOR PHYSICALLY DISABLED PEOPLE”** done by me under the guidance of **Mr.J.SENTHILKUMAR.M.E.,(Ph.D)** is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Mechanical Engineering.

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ABSTRACT

The humanoid robots are one of the most important and exciting research topics in robotics. There always have been two types of research activities on humanoid. The first is the scientific interest trying to understand the human behavior in computational scientific ways and the second is the “simply” to develop a humanoid in order to use it practically. In this project, 3D printed robotic humanoid hand is created to mimic a human user’s hand motions in a real time manner. First, the motions of the human hand are captured by a sensor. Then the gesture of the user hand is passed to an Arduino. Finally, the microcontroller detects the original motion of the hand and then the correspond in action is carried at the developed robotic arm. The commands to the servomotors of the robotic hand to implement the required gesture. In order to ensure that the motion of the robotic hand matches the minimum speed requirements. The robotic model is implemented using the arduino and results show that the robotic hand was able to mimic a human user’s finger motions successfully in a real time way. In this paper, a robotic humanoid hand was developed and created, which could mimic a human user’s finger motions.

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LIST OF SYMBOLS AND ABBREVIATIONS

CNN	Convolutional Neural Network
RNNS	Recurrent Neural Network
ILSVRC	ImageNet Large Scale Visual Recognition Challenge
ReLU	Rectified Linear Unit
SARSA	State-Action-Reward-State-Action
DDPG	Deep Deterministic Policy Gradient

CHAPTER -1

INTRODUCTION

GENERAL

A robot is a machine—especially one programmable by a computer—capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed on the lines of human form, but most robots are machines designed to perform a task with no regard to their aesthetics. Robots in medicine help by relieving medical personnel from routine tasks, that take their time away from more pressing responsibilities, and by making medical procedures safer and less costly for patients. They can also perform accurate surgery in tiny places and transport dangerous substances.

Robotic technologies appear in many areas that directly affect patient care. They can be used to disinfect patient rooms and operating suites, reducing risks for patients and medical personnel. They work in laboratories to take samples and then to transport, analyze, and store them. This is especially good news if you have ever had blood drawn by someone who had to try several times to find a "good vein." The robotic lab assistant can locate that vessel and draw the blood with less pain and anxiety for the patient. Robots also prepare and dispense medications in pharmacological labs. In larger facilities robotic carts carry bed linens and even meals from floor to floor, riding elevators and maneuvering through automatic doors. There are also "gears and wires" robotic assistants that help paraplegics move and can administer physical therapy.

Robotic personal assistants can be built to look friendly and the Japanese have taken the lead on this front. One of their machines, called

Paro, responds to human speech and looks like a decidedly non-threatening baby seal. Other robotic technology is humanoid and used for help with personal care, socialization and for training. One used in training emergency personnel to respond to trauma, for instance, looks like a victim who screams, bleeds and even responds to treatment.

TECHNOLOGY USED

Robotics

Robotics is an interdisciplinary research area at the interface of computer science and engineering. Robotics involves design, construction, operation, and use of robots. The goal of robotics is to design intelligent machines that can help and assist humans in their day-to-day lives and keep everyone safe. Robotics draws on the achievement of information engineering, computer engineering, mechanical engineering, electronic engineering and others.

Robotics develops machines that can substitute for humans and replicate human actions. Robots can be used in many situations and for many purposes, but today many are used in dangerous environments (including inspection of radioactive materials, bomb detection and deactivation), manufacturing processes, or where humans cannot survive (e.g. in space, underwater, in high heat, and clean up and containment of hazardous materials and radiation). Robots can take on any form but some are made to resemble humans in appearance. This is said to help in the acceptance of a robot in certain replicative behaviors usually performed by people. Such robots attempt to replicate walking, lifting, speech, cognition, or any other human activity. Many of today's robots are inspired by nature, contributing to the field of bio-inspired robotics.

The concept of creating robots that can operate autonomously dates back to classical times, but research into the functionality and potential uses of robots did not grow substantially until the 20th century. Throughout history, it has been frequently assumed by various scholars, inventors, engineers, and technicians that robots will one day be able to mimic human behavior and manage tasks in a human-like fashion. Today, robotics is a rapidly growing field, as technological advances continue; researching, designing, and building new robots serve various practical purposes, whether domestically, commercially, or militarily. Many robots are built to do jobs that are hazardous to people, such as defusing bombs, finding survivors in unstable ruins, and exploring mines and shipwrecks. Robotics is also used in STEM (science, technology, engineering, and mathematics) as a teaching aid.

Embedded systems

An embedded system is a microprocessor-based computer hardware system with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system. At the core is an integrated circuit designed to carry out computation for real-time operations.

Complexities range from a single microcontroller to a suite of processors with connected peripherals and networks; from no user interface to complex graphical user interfaces. The complexity of an embedded system varies significantly depending on the task for which it is designed.

Embedded system applications range from digital watches and microwaves to hybrid vehicles and avionics. As much as 98 percent of all microprocessors manufactured are used in embedded systems.

Embedded systems are managed by microcontrollers or digital signal processors (DSP), application-specific integrated circuits (ASIC), field-programmable gate arrays (FPGA), GPU technology, and gate arrays. These processing systems are integrated with components dedicated to handling electric and/or mechanical interfacing.

Embedded systems programming instructions, referred to as firmware, are stored in read-only memory or flash memory chips, running with limited computer

hardware resources. Embedded systems connect with the outside world through peripherals, linking input and output devices.

Structure of embedded systems

The basic structure of an embedded system includes the following components:

Sensor: The sensor measures and converts the physical quantity to an electrical signal, which can then be read by an embedded systems engineer or any electronic instrument. A sensor stores the measured quantity to the memory.

A-D Converter: An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal.

Processor & ASICs: Processors assess the data to measure the output and store it to the memory.

D-A Converter: A digital-to-analog converter changes the digital data fed by the processor to analog data

Actuator: An actuator compares the output given by the D-A Converter to the actual output stored and stores the approved output.

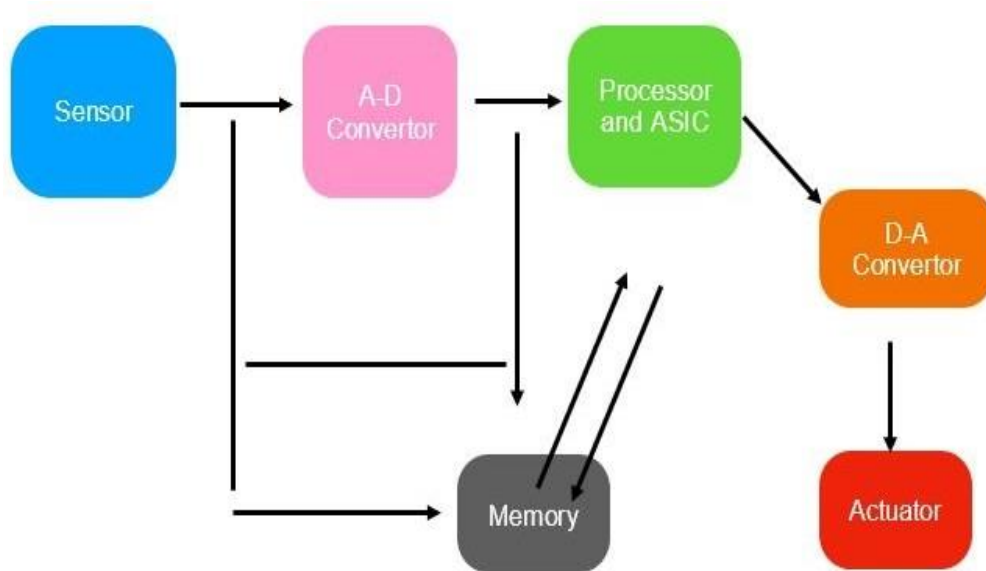


Figure 1.2: Structure of embedded systems

OBJECTIVE:

- The objective of the project is to design a robot that can enable handless people to use a robot in place of their hand.
- To effectively capture the hand gestures from one hand and use it as direction for the other hand.

CHAPTER -2

LITERATURE SURVEY

INTRODUCTION

The following shows survey on robots. The most popular of the existing techniques used for building of robots.

LITERATURE SURVEY

John Nassour*, Hojjat Gharaei Amirabadi, Saddam Weheabby, Abbas Al Ali, Heinrich Lang, and Fred Hamker ,“A Robust Data-Driven Soft Sensory Glove for Human Hand Motions Identification and Replication”

Biomechanical sensors are essential components for wearable robots because of their broad spectrum of industrial and medical applications. A wide range of these sensors uses soft materials with deformation-related electrical properties, namely variable resistors and capacitors. Previously, conductive materials were injected into silicone structures that require several molding steps to build the microchannels. This paper proposes a versatile soft sensing glove, using a simple process for preparing sensors of different sizes without molding. We used commercially available silicone tubes to host the conductive liquid. Ten sensors were attached to the back side of the glove to measure flexion-extension and four sensors were placed on the glove at the interdigital folds between the fingers to measure abduction-adduction. The sensory glove successfully replicates hand motion. We used machine learning algorithms to estimate the angles of the joints in the hand and also to identify 15 gestures. The system's robustness was evaluated in two experiments. The gesture prediction is robust to shocks from contact with a punching ball and also submersion of the glove in water. The proposed sensory glove overcomes challenges of comfort, rigidity, and robustness. It

can be used, therefore, to replicate human hand motion in industrial and medical applications.

Pros:

The sensory glove overcomes challenges of comfort, rigidity, and robustness. It can be used, therefore, to replicate human hand motion in industrial and medical applications.

Cons:

Only predicts the hand gestures and no real time application is developed using this system.

Asif Khan, Bernhard Rinner, Senior Member, IEEE, and Andrea Cavallaro,” Cooperative Robots to Observe Moving Targets: Review”

The deployment of multiple robots for achieving a common goal helps to improve the performance, efficiency, and/or robustness in a variety of tasks. In particular, the observation of moving targets is an important multirobot application that still exhibits numerous open challenges, including the effective coordination of the robots. This paper reviews control techniques for cooperative mobile robots monitoring multiple targets. The simultaneous movement of robots and targets makes this problem particularly interesting, and our review systematically addresses this cooperative multirobot problem for the first time. We classify and critically discuss the control techniques: cooperative multirobot observation of multiple moving targets, cooperative search, acquisition, and track, cooperative tracking, and multirobot pursuit evasion. We also identify the five major elements that characterize this problem, namely, the coordination method, the environment, the target, the robot and its sensor(s). These elements are used to systematically analyze the control techniques. The majority of the studied work is based on simulation and

laboratory studies, which may not accurately reflect real-world operational conditions. Importantly, while our systematic analysis is focused on multitarget observation, our proposed classification is useful also for related multirobot applications.

Pros:

The system is useful also for related multi-robot applications.

Cons:

The system does not provide an option for remote controlled movement.

Shuai Li, Ruofan Kong, and Yi Guo, Senior Member, IEEE, "Cooperative Distributed Source Seeking by Multiple Robots: Algorithms and Experiments"

We consider the problem of source seeking using a group of mobile robots equipped with sensors for source concentration measurement. In the formulation, the robot team cooperatively estimates the gradient of the source field, moves to the source by tracing the gradient-ascending direction, and keeps a predefined formation in movement. We present two control algorithms with all-to-all and limited communications, respectively. For the

case of all-to-all communication, rigorous analytic analysis proves that the formation center of the robots converges to the source in the presence of estimation errors with a bounded error, the upper bound of which is explicitly given. In the case of limited communication where centralized quantities are not available, distributed consensus filters are used to distributively estimate the centralized quantities, and then embedded in the distributed control laws. Numerical simulations are given to validate the effectiveness of the proposed approaches. Experimental results on the E-

puck robot platform demonstrate satisfactory performances in a light source seeking application.

Pros:

Results on the E-puck robot platform demonstrate satisfactory performances in a light source seeking application.

Cons:

The system involves multiple robots, hence is not applicable.

Olzhas Adiyatov , Student Member, IEEE, Bexultan Rakhim, Altay Zhakatayev , Member, IEEE, and Huseyin Atakan Varol , Senior Member, IEEE,” Sensor Reduction of Variable Stiffness Actuated Robots Using Moving Horizon Estimation”

Variable stiffness actuated (VSA) robots are expected to play an important role in physical human–robot interaction, thanks to their inherent safety features. These systems can control the position and stiffness concurrently by incorporating two or more actuators for each joint. Unfortunately, the need for extra sensors to measure the state of these actuators decreases the reliability of these systems. In this paper, we present a sensor reduction scheme for VSA robots. Specifically, we utilize moving horizon estimation (MHE) to estimate the unmeasured states of the system. Due to its ability to handle constraints, MHE is chosen as the estimation algorithm. The estimated states are then used by a nonlinear model predictive controller to implement a closed-loop control system. In order to show the efficacy of our framework, we conducted extensive simulation and real world experiments with a reaction wheel augmented VSA system. The objective of these experiments was to compare the control performance of the sensor reduced system (from four encoders to two encoders) with the system using the full set of states for control. The results of these experiments show the feasibility of the MHE-based sensor

reduction. Sensor reduction might increase the reliability of VSA robots and might facilitate their earlier introduction to the industrial environments.

Pros:

Produces very good accuracy compared to other state-of-the-art methods

Cons:

It inflexible for movement, hence is not feasible for large scale usage.

J. García, A. Bohórquez, and A. Valero,” Suspension Effect in Tip-Over Stability and Steerability of Robots Moving on Sloping Terrains”

This article describes a model for a skid steer robot that quantifies the reaction forces between the wheels and the ground, which includes the effect of the passive suspension when the robot moves on flat and inclined terrains. In addition to the internal parameters of the suspension, this model included external parameters related to other components of robot and the robot terrain relationship. With this model, which was validated through simulation, it was studied the effect that suspension produces in tip-over stability and steerability of robot when it moves on different terrain inclinations, specifically when the parameters of suspension system and wheel-ground contact are varied.

Pros:

The results are very satisfying, making it applicable for real time applications.

Cons:

The robot cannot be directed to move in the desired direction making it not feasible.

Milan Lukic, Ahmed Barnawi, Member, IEEE, and Ivan Stojmenovic, Fellow, IEEE,” Robot Coordination for Energy-Balanced Matching and Sequence Dispatch of Robots to Events”

Given a set of events and a set of robots, the dispatch problem is to allocate one robot for each event to visit it. In a single round, each robot may be allowed to visit only one event (matching dispatch), or several events in a sequence (sequence dispatch). In a distributed setting, each event is discovered by a sensor and reported to a robot. Here, we present novel algorithms aimed at overcoming the shortcomings of several existing solutions. We propose pairwise distance based matching algorithm (PDM) to eliminate long edges by pairwise exchanges between matching pairs. Our sequence dispatch algorithm (SQD) iteratively finds the closest event-robot pair, includes the event in dispatch schedule of the selected robot and updates its position accordingly. When event-robot distances are multiplied by robot resistance (inverse of the remaining energy), the corresponding energy-balanced variants are obtained. We also present generalizations which handle multiple visits and timing constraints. Our localized algorithm MAD is based on information mesh infrastructure and local auctions within the robot network for obtaining the optimal dispatch schedule for each robot. The simulations conducted confirm the advantages of our algorithms over other existing solutions in terms of average robot-event distance and lifetime.

Pros:

The simulations conducted confirm the advantages of our algorithms over other existing solutions in terms of average robot-event distance and lifetime.

Cons:

The system cannot be used for the betterment of general applications.

Jing Li; Qiang Huang; Zhangguo Yu; Xuechao Chen; Weimin Zhang; Huaxin Liu; Junyao Gao; Yingxian Duo,” Integral Acceleration Generation for Slip Avoidance in a Planar Humanoid Robot”

Slip occurrence puts not only the humans but also the humanoid robots into dangerous situations. Although the detection and the estimation of slip have been well researched, studies on slip avoidance control in a humanoid robot are rare. Previous methods used to restrict the horizontal motion or regulate the vertical motion of the humanoid robot did not take the important rotational motion into account. This study proposes an integral acceleration generation method for slip avoidance that meets the real-time requirements, using the sagittal plane as an example. The proposed method makes full use of all the motions related to the slip in the sagittal plane to prevent the slip, including the translational and the rotational motions. The simulations and experiments on the physical humanoid robot demonstrate the effectiveness of the presented method.

Pros:

The proposed method makes full use of all the motions related to the slip in the sagittal plane to prevent the slip, including the translational and the rotational motions.

Cons:

Although the detection and the estimation of slip have been well researched, studies on slip avoidance control in a humanoid robot are rare.

Guillaume Doisy; Joachim Meyer; Yael Edan,” The Impact of Human–Robot Interface Design on the Use of a Learning Robot System ”

There is limited knowledge on how to design effective interfaces to enable nonexpert users to interact with robot learning algorithms. This paper focuses on an interface design challenge: How to provide the user with sufficient information about the learned behavior. A simulated robotic task where the robot has online learning capabilities was developed. This platform was used to study the impact of the variability of the environmental conditions, the information provided on the relation between the learned robot behavior and the conditions in the environment, and the presence of a preview of the learned robot behavior on the use of the system and on task performance. The results show significant effects of the type and the quantity of displayed information. Forty-two participants made the best use of brief and contextualized notifications about changes in the environment: their presence improved the overall performance and the usage of the automation and reduced the workload. In contrast, adding previews of the learned behavior surprisingly impaired performance and reduced the use of automation.

Pros:

In contrast, adding previews of the learned behavior surprisingly impaired performance and reduced the use of automation.

Cons:

The results are not accurate enough, making it not practical for real time applications.

Feng Gu; Yuqing He; Jianda Han," Active Persistent Localization of a Three-Dimensional Moving Target Under Set- Membership Uncertainty Description Through Cooperation of Multiple Mobile Robots"

The persistent localization of moving targets is one of the most important applications of mobile robot systems. However, the sensors on

each individual robot are often not sufficiently accurate for this task, presenting a severe limitation on the application of robots to many situations. To overcome this problem, systems of multiple robots have been established. These systems improve the localization accuracy of mobile targets by fusing together multiple sensing data. Numerous studies have demonstrated that the relative motion (or specifically, the relative pose) between the robot and the target, as well as that among different robots, strongly influences the final localization accuracy of the data fusion algorithm. In other words, the regulation of motion in a multiple-robot system will lead to better localization results. Thus, in this paper, a new active persistent localization (APL) scheme is proposed. The underlying concept of this scheme is based on set-membership descriptions of uncertainties. The basic problem is formulated in the framework of an enhanced set-membership filter, and a new data fusion algorithm with improved accuracy and convergence properties is designed. A motion-planning algorithm is then incorporated under the so-called optimal localization condition to complete the APL scheme. Simulations using multiple 3-D mobile robot systems and experiments on a multiple rotor-flying-robots test bed show that the proposed algorithm successfully enhances the accuracy of the persistent localization of the moving target.

Pros:

Experiments on a multiple rotor-flying-robots test bed show that the proposed algorithm successfully enhances the accuracy of the persistent localization of the moving target.

Cons:

The sensors on each individual robot are often not sufficiently accurate for this task.

C. Serkan Karagöz; H. Işıl Bozma; Daniel E. Koditschek,” Coordinated Navigation of Multiple Independent Disk-Shaped Robots”

This paper addresses the coordinated navigation of multiple independently actuated disk-shaped robots-all placed within the same disk-shaped workspace. Assuming perfect sensing, shared-centralized communications and computation, as well as perfect actuation, we encode complete information about the goal, obstacles, and workspace boundary using an artificial potential function over the configuration space of the robots' simultaneous nonoverlapping positions. The closed-loop dynamics governing the motion of each (velocity-controlled) robot take the form of the appropriate projection of the gradient of this function. We impose (conservative) restrictions on the allowable goal positions that yield sufficient conditions for convergence: We prove that this construction is an essential navigation function that guarantees collision-free motion of each robot to its destination from almost all initial free placements. The results of an extensive simulation study investigate practical issues such as average resulting trajectory length and robustness against simulated sensor noise.

Pros:

The results of an extensive simulation study investigate practical issues such as average resulting trajectory length and robustness against simulated sensor noise.

Cons:

The results are not up to realistic expectations.

Guanglong Du; Mingxuan Chen; Caibing Liu; Bo Zhang; Ping Zhang,” Online Robot Teaching With Natural Human–Robot Interaction”

With the development of Industry 4.0, robots tend to be intelligent and collaborative. For one, robots can interact naturally with humans. For another, robots can work collaboratively with humans in a common area. The traditional teaching method is no longer suitable for the production mode with human-robot collaboration. Since the traditional teaching processes are complicated, they need highly skilled staffs. This paper focuses on the natural way of online teaching, which can be applied to the tasks such as welding, painting, and stamping. This paper presents an online teaching method with the fusion of speech and gesture. A depth camera (Kinect) and an inertial measurement unit are used to capture the speech and gesture of the human. Interval Kalman filter and improved particle filter are employed to estimate the gesture. To integrate speech and gesture information more deeply, a novel method of audio-visual fusion based on text is proposed, which can extract the most useful information from the speech and gestures by transforming them into text. Finally, a maximum entropy algorithm is employed to deal with the fusion text into the corresponding robot instructions. The practicality and effectiveness of the proposed approach were validated by five subjects without robot teaching skills. The results indicate that the online robot teaching system can successfully teach robot manipulators.

Pros:

The results indicate that the online robot teaching system can successfully teach robot manipulators.

Cons:

The traditional teaching method is no longer suitable for the production mode with human-robot collaboration.

P.H.L. Silva; A.M.F. Burlamaqui,” System for Creation, Programming and Availability of Distributed Robot Teams using Collective Knowledge ”

This paper addresses the problem of programming, control and availability of distributed robots teams. Systems based on robots working together collaboratively has been the subject of much research in recent years. Because the rapid spread of technologies in mobile devices and Internet, as well as the benefits that robotics adds to the various everyday applications, the trend is that more and more it is present in various activities of human beings. For distributed robots systems there is a latent need for research to enable the use of such systems by end users with no or almost no experience with programming or robotics. Thus, this paper proposes a system architecture that allows the creation and programming of robots teams, allowing and users to manage them as a single system and simple way using collective knowledge acquired both programmers as of the and users. The tests are performed by an application that was developed under the concepts of this architecture. It provides a set of special operations by which and users can connect, create and control robots teams at high level. The experiments use LEGO Mindstorms® robots as members of two robot teams. The process of creation, programming and control of the teams is presented in well defined steps. The results are satisfactory and show that the operating strategy of the proposed system meets fundamental aspects at the system level such as modularity, flexibility and ease of access for end users.

Pros:

The results are satisfactory and show that the operating strategy of the proposed system meets fundamental aspects at the system level such as modularity, flexibility and ease of access for end users

Cons:

The project is not feasible for automated robots.

F.A.G. Becerra; A. B. Ortega; C. D. G. Beltrán; C. G. Valdivia; R.O.D. Arcega,” Design and control of a new parallel robot for the rehabilitation of the hip-knee”

The use of robots for passive medical rehabilitation has grown substantially in recent years due to the importance of achieving normality after having suffered an injury in any joint of the human body. In the present work we propose a new robot of rehabilitation for hip flexion movement that consists of two linear guide systems in the Z and Y axes. The kinetic analysis of the robot is made, proposing a new kinematic model of five Links. The geometric relationship between the linear guide and the flexion angle is used in such a way that it would be only necessary to measure the position of the linear guide without the measurement of the flexion angle of the hip. The mathematical model of the linear guides includes the dynamics of the CD motors, and a law of control GPI robust is proposed to control the position of the guides.

Pros:

The mathematical model of the linear guides includes the dynamics of the CD motors, and a law of control GPI robust is proposed to control the position of the guides.

Cons:

The robot positioning is not properly identified leaving more scope for improvement.

Prasanna Kumar Sivakumar, Chittaranjan S Srinivas,” Robot-Human Hand-Overs in Non-Anthropomorphic Robots”

Robots that assist and interact with humans will inevitably require to successfully achieve the task of handing over objects. Whether it is to deliver desired objects for the elderly living in their homes or hand tools to a worker in a factory, the process of robot hand-overs is one worthy study within the human robot interaction community. While the study of object hand-overs have been studied in previous works , these works have mainly considered anthropomorphic robots, that is, robots that appear and move similar to humans. However, recent trends within robotics, and in particular domestic robotics have witnessed an increase in non-anthropomorphic robotic platforms such as moving tables , teleconferencing robots and vacuum cleaners. The study of robot hand-over for nonanthropomorphic robots and in particular the study of what constitute a successful hand-over is at focus in this paper. For the purpose of investigation, the TurtleBot1 , which is a moving table like device is used in a home environment.

Pros:

The system provides a framework to assess engineering risk and the wider financial implications of the new technologies as they are introduced.

Cons:

The system is not recommended, the vehicles are not accurately recognized using this feature.

Matthew Field; David Stirling; Zengxi Pan; Fazel Naghdy,” Learning Trajectories for Robot Programing by Demonstration Using a Coordinated Mixture of Factor Analyzers”

This paper presents an approach for learning robust models of humanoid robot trajectories from demonstration. In this formulation, a model of the joint space trajectory is represented as a sequence of motion primitives where a nonlinear dynamical system is learned by constructing a

hidden Markov model (HMM) predicting the probability of residing in each motion primitive. With a coordinated mixture of factor analyzers as the emission probability density of the HMM, we are able to synthesize motion from a dynamic system acting along a manifold shared by both demonstrator and robot. This provides significant advantages in model complexity for kinematically redundant robots and can reduce the number of corresponding observations required for further learning. A stability analysis shows that the system is robust to deviations from the expected trajectory as well as transitional motion between manifolds. This approach is demonstrated experimentally by recording human motion with inertial sensors, learning a motion primitive model and correspondence map between the human and robot, and synthesizing motion from the manifold to control a 19 degree-of-freedom humanoid robot.

Pros:

This approach is demonstrated experimentally by recording human motion with inertial sensors, learning a motion primitive model and correspondence map between the human and robot, and synthesizing motion from the manifold to control a 19 degree-of-freedom humanoid robot.

Cons:

Accuracy is not up to the mark, leaving larger scope for improvement.

DISADVANTAGES IN EXISTING SYSTEM

- The system only focuses on identifying hand gesture movements of the person using sensors
- The system does not in any help handless people regain movement of their hands
- There is no real time application can be done using this system

CHAPTER - 3

SYSTEM ANALYSIS

EXISTING SYSTEM:

This article proposes a standalone radio frequency identification (RFID)-based mobile robot navigation method, in which a mobile robot equipped with reader antennas can be continuously guided to a static object marked with a single passive UHF RFID tag. An observation model based on the RFID phase difference is built and integrated into a particle filter, by which the instantaneous relative position between the mobile robot and the tagged object can be detected in real time. Based on the position information extracted from the RFID system, the mobile robot adjusts its pose to move toward the RFID-tagged object. Compared with the existing RFID-based mobile robot navigation methods, the proposed method requires no external sensors other than the RFID and requires only a single passive tag. Experiments using commercial off-the-shelf (COTS) RFID devices are performed, and the results indicate that the mobile robot can satisfactorily realize navigation task with a distance accuracy of 4.04 cm and a bearing accuracy of 2.23°. The proposed method is well applicable for the navigation scenes in which the absolute position of the tagged target object is not known beforehand.

DISADVANTAGES OF EXISTING SYSTEM:

- The system is RFID based making it inflexible for movement.
- The system reader antennas making it not feasible for extensive real time applications.
- The system is not applicable for medical purposes, it cannot be used to treat patients.

- The movement of the robot cannot be lively monitored or controlled.

PROPOSED SYSTEM:

The humanoid robots are one of the most important and exciting research topics in robotics. There always have been two types of research activities on humanoid. The first is the scientific interest trying to understand the human behavior in computational scientific ways and the second is the “simply” to develop a humanoid in order to use it practically. In this project, 3D printed robotic humanoid hand is created to mimic a human user’s hand motions in a real time manner. First, the motions of the human hand are captured by a sensor. Then the gesture of the user hand is passed to an Arduino. Finally, the microcontroller sends the control to wireless sensor networks. Then the original motion of the hand is decoded at the receiver section then the correspond in action is carried at the developed robotic arm. The commands to the servomotors of the robotic hand to implement the required gesture. In order to ensure that the motion of the robotic hand matches the minimum speed requirements. The robotic model is implemented using the arduino and results show that the robotic hand was able to mimic a human user’s finger motions successfully in a real time way. In this paper, a robotic humanoid hand was developed and created, which could mimic a human user’s finger motions.

ADVANTAGES:

- Safe and effective solution enabling handless people regain access of their lost hands.
- Useful in places where human interference is dangerous.
- Useful in production industries

APPLICATIONS:

- Useful for disabled people

- Useful for handicap people
- Useful for paralyzed people

CHAPTER 4

SYSTEM DESIGN

DETAILED DESIGN OF THE PROJECT:

This chapter describes the overall and the detailed architectural design. It also describes each module that is to be implemented along with Data Flow diagram.

ARCHITECTURE DIAGRAM:

The architectural diagram is shown in Figure 4.1

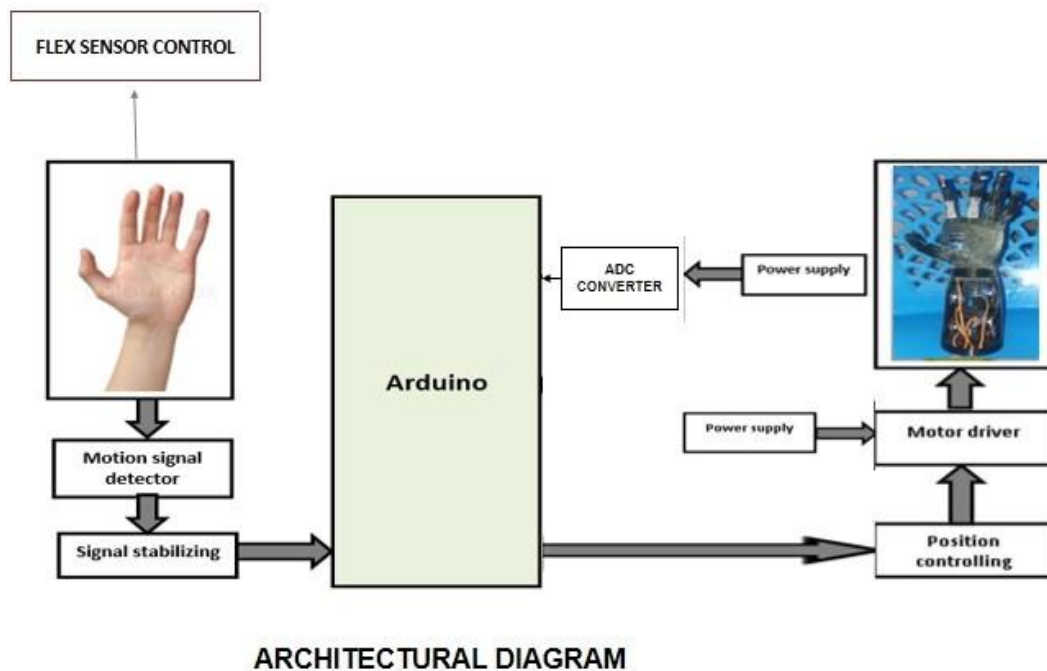


Figure 4.1 System Architecture

WORKING:

In this project, 3D printed robotic humanoid hand is created to mimic a human user's hand motions in a real time manner. First, the motions of the human hand are captured by a sensor. Then the gesture of the user hand is passed to an Arduino. Finally, the microcontroller detect the original motion of the hand is then the correspond in action is carried at the developed robotic arm. The commands to the servomotors of the robotic hand to implement the required gesture. In order to ensure that the motion of the robotic hand matches the minimum speed requirements. The robotic model is implemented using the arduino and results show that the robotic hand was able to mimic a human user's finger motions successfully in a real time way. In this paper, a robotic humanoid hand was developed and created, which could mimic a human user's finger motions.

MODULE DESCRIPTION:

- Power supply Module
- Microcontroller module
- Servo motor module

POWER SUPPLY MODULE:

The power supply circuit consists of step-down transformer which is 230v step down to 12v. In this circuit 4 diodes are used to form bridge rectifier which delivers pulsating dc voltage & then fed to capacitor filter the output voltage from rectifier is fed to filter to eliminate any A.C. components present even after rectification.

The filtered DC voltage is given to regulator to produce 12v constant

DC voltage. 230V AC power is converted into 12V AC (12V RMS value wherein the peak value is around 17V), but the required power is 5V DC; for this purpose, 17V AC power must be primarily converted into DC power then it can be stepped down to the 5V DC. AC power can be converted into DC using one of the power electronic converters called as Rectifier. There are different types of rectifiers, such as half-wave rectifier, full-wave rectifier and bridge rectifier. Due to the advantages of the bridge rectifier over the half and full wave rectifier, the bridge rectifier is frequently used for converting AC to DC.

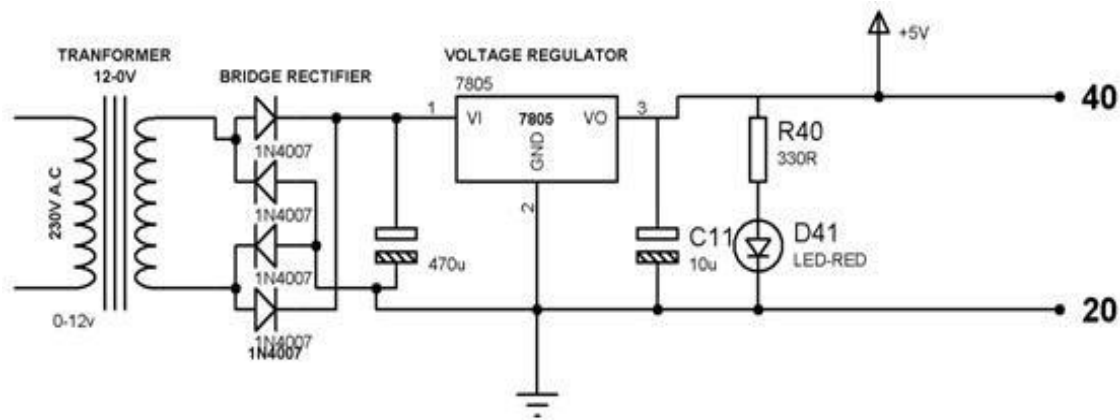


Figure: 4.2 Power supply

MICROCONTROLLER MODULE

ATmega-328 is basically an Advanced Virtual RISC (AVR) microcontroller. It supports the data up to eight (8) bits. ATmega-328 has 32KB internal built-in memory. This microcontroller has a lot of other characteristics. You should also have a look at Introduction to PIC16F877a (it's a PIC Microcontroller) and then compare functions of these two Microcontrollers. ATmega 328 has 1KB Electrically Erasable

Programmable Read Only Memory (EEPROM). This property shows if the electric supply supplied to the micro-controller is removed, even then it can store the data and can provide results after providing it with the electric supply. Moreover, ATmega-328 has 2KB Static Random Access Memory (SRAM). Other characteristics will be explained later. ATmega 328 has several different features which make it the most popular device in today's market. These features consist of advanced RISC architecture, good performance, low power consumption, real timer counter having separate oscillator, 6 PWM pins, programmable Serial USART, programming lock for software security, throughput up to 20 MIPS etc. ATmega-328 is mostly used in Arduino.

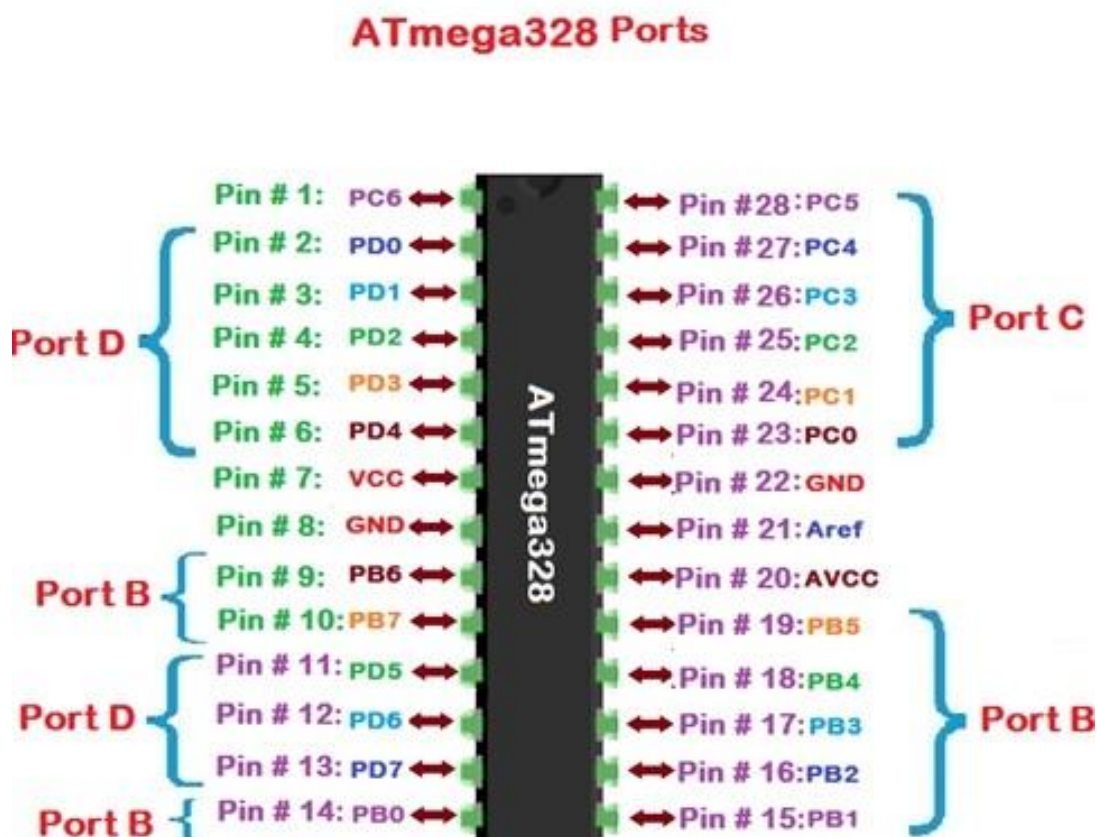


Figure: 4.3 Atmega 328 architecture

Features

- High Performance, Low Power AVR® 8-Bit Microcontroller Family
- Advanced RISC Architecture
- 131 Powerful Instructions
- Most Single Clock Cycle Execution
- 32 x 8 General Purpose Working Registers Fully Static Operation
- Up to 20 MIPS Throughput at 20MHz On-chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
- 4/8/16/32KBytes of In-System Self-Programmable Flash program memory
- 256/512/512/1KBytes EEPROM
- 512/1K/1K/2KBytes Internal SRAM
- Write/Erase Cycles: 10,000 Flash/100,000 EEPROM
- Data retention: 20 years at 85°C/100 years at 25°C(1)
- Optional Boot Code Section with Independent Lock Bits
- In-System Programming by On-chip Boot Program
- Real Time Counter with Separate Oscillator
- Six PWM Channels
- 8-channel 10-bit ADC in TQFP and QFN/MLF package
- Temperature Measurement
- 6-channel 10-bit ADC in PDIP Package
- Temperature Measurement
- Programmable Serial USART

- Master/Slave SPI Serial Interface
- Byte-oriented 2-wire Serial Interface (Philips I2C compatible)
- Programmable Watchdog Timer with Separate On-chip Oscillator
- On-chip Analog Comparator
- Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
- Power-on Reset and Programmable Brown-out Detection
- Internal Calibrated Oscillator
- External and Internal Interrupt Sources
- Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages 23 Programmable I/O Lines 28-pin PDIP, 32-lead TQFP, 28-pad QFN/MLF and 32-pad QFN/MLF
- Operating Voltage: 1.8 - 5.5V
- Temperature Range: -40°C to 85°C
- Speed Grade: 0 - 4MHz@1.8 - 5.5V, 0 - 10MHz@2.7 - 5.5.V, 0 - 20MHz @ 4.5 - 5.5V
- Power Consumption at 1MHz, 1.8V, 25°C
- Active Mode: 0.2mA Power-down Mode: 0.1μA
- Power-save Mode: 0.75μA (Including 32kHz RTC)

SERVO MOTOR MODULE

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If the motor is DC powered then it is called a DC servo motor, and if it is AC powered motor then it is called an AC servo motor. We can get a very high torque servo motor in a small and light weight package. Due to these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.



Figure: 4.4 Servo motor

Servo motors are rated in kg/cm (kilogram per centimeter). Most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motor's shaft, the greater the distance the lesser the weight carrying capacity.

The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

CHAPTER 5

SOFTWARE DESCRIPTION

VISUAL STUDIO

In this project Microsoft visual studio is used as IDE.

Visual Studio Code combines the simplicity of a source code editor with powerful developer tooling, like IntelliSense code completion and debugging.

First and foremost, it is an editor that gets out of your way. The delightfully frictionless edit-build-debug cycle means less time fiddling with the environment, and more time executing on ideas.

Visual Studio Code supports macOS, Linux, and Windows - allowing the ground running, no matter the platform.

At its heart, Visual Studio Code features a lightning fast source code editor, perfect for day-to-day use. With support for hundreds of languages, VS Code helps in being instantly productive with syntax highlighting, bracket-matching, auto-indentation, box-selection, snippets, and more. Intuitive keyboard shortcuts, easy customization and community-contributed keyboard shortcut mappings lets navigation of code with ease.

For serious coding, the benefit is from tools with more code understanding than just blocks of text. Visual Studio Code includes built-in support for IntelliSense code completion, rich semantic code understanding and navigation, and code refactoring.

And when the coding gets tough, the tough get debugging. Debugging is often the one feature that developers miss most in a leaner coding experience, so it is made to happen. Visual Studio Code includes an interactive debugger, so one can step through source code, inspect variables, view call stacks, and execute commands in the console.

VS Code also integrates with build and scripting tools to perform common tasks making everyday workflows faster. VS Code has support

for Git so anyone can work with source control without leaving the editor including viewing pending changes diffs.

Allows customization of every feature to the liking of the user and install any number of third-party extensions. While most scenarios work "out of the box" with no configuration, VS Code also grows along with the user, and encourages user to optimize your experience to suit his/her unique needs.

VS Code includes enriched built-in support for Node.js development with JavaScript and TypeScript, powered by the same underlying technologies that drive Visual Studio. VS Code also includes great tooling for web technologies such as JSX/React, HTML, CSS, SCSS, Less, and JSON.

Architecturally, Visual Studio Code combines the best of web, native, and language-specific technologies. Using Electron, VS Code combines web technologies such as JavaScript and Node.js with the speed and flexibility of native apps. VS Code uses a newer, faster version of the same industrial-strength HTML-based editor that has powered the "Monaco" cloud editor, Internet Explorer's F12 Tools, and other projects. Additionally, VS Code uses a tools service architecture that enables it to integrate with many of the same technologies that power Visual Studio, including Roslyn for .NET, TypeScript, the Visual Studio debugging engine, and more.

Visual Studio Code includes a public extensibility model that lets developers build and use extensions, and richly customize their edit-build-debug experience.

EMBEDDED C

In this project the embedded C is used.

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all device working is based on microcontroller that are programmed by embedded C.

Embedded C is perhaps the most popular languages among Embedded Programmers for programming Embedded Systems. There are many popular programming languages like Assembly, BASIC, C++ etc. that are often used for developing Embedded Systems but Embedded C remains popular due to its efficiency, less development time and portability.

Comments: Comments are readable text that are written to help us (the reader) understand the code easily. They are ignored by the compiler and do not take up any memory in the final code (after compilation).

There are two ways you can write comments: one is the single line comments denoted by `//` and the other is multiline comments denoted by `/*....*/`.

Preprocessor Directive: A Preprocessor Directive in Embedded C is an indication to the compiler that it must look in to this file for symbols that are not defined in the program.

In C Programming Language (also in Embedded C), Preprocessor Directives are usually represented using `#include...` or `#define...`

In Embedded C Programming, we usually use the preprocessor directive to indicate a header file specific to the microcontroller, which contains all the SFRs and the bits in those SFRs.

In case of 8051, Keil Compiler has the file “reg51.h”, which must be written at the beginning of every Embedded C Program.

Global Variables: Global Variables, as the name suggests, are Global to the program i.e. they can be accessed anywhere in the program.

Local Variables: Local Variables, in contrast to Global Variables, are confined to their respective function.

Main Function: Every C or Embedded C Program has one main function, from where the execution of the program begins.

CHAPTER-6

RESULTS AND DISCUSSIONS

FINAL OUTPUTS OBTAINED:

The below image shows the complete hardware setup of the robotic hand:

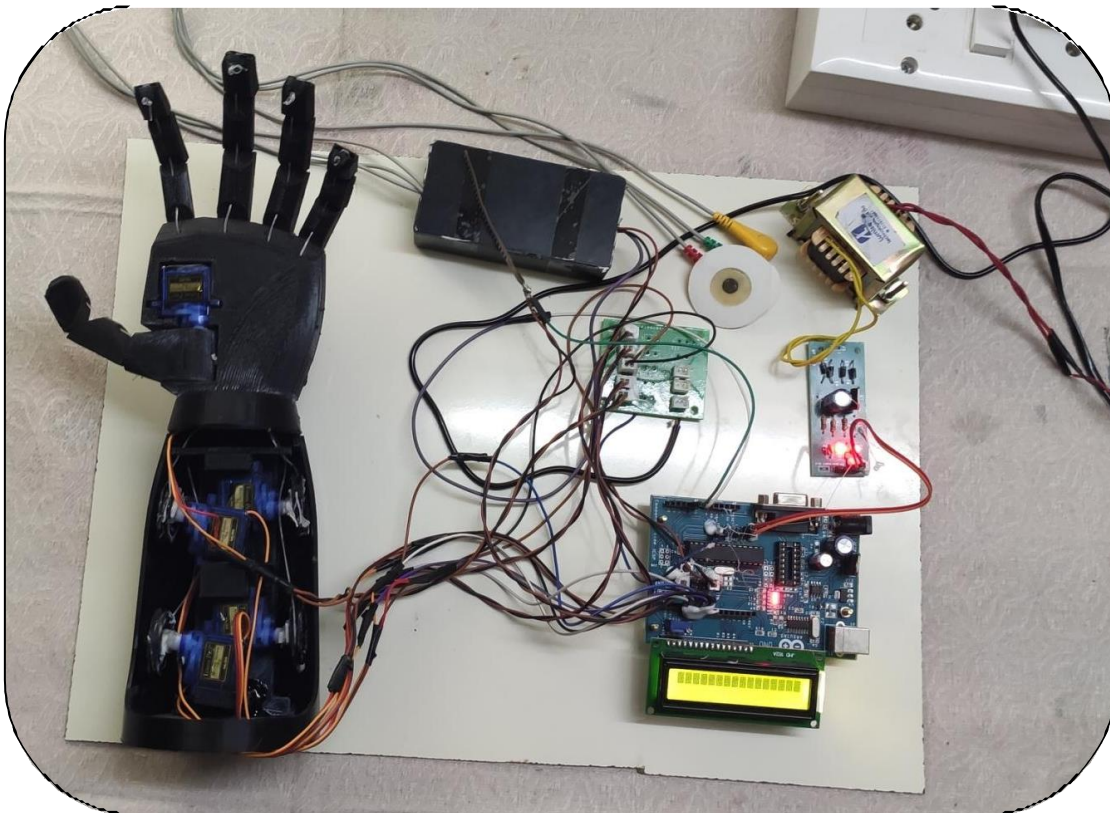


Figure 6.1:Robotic hand setup

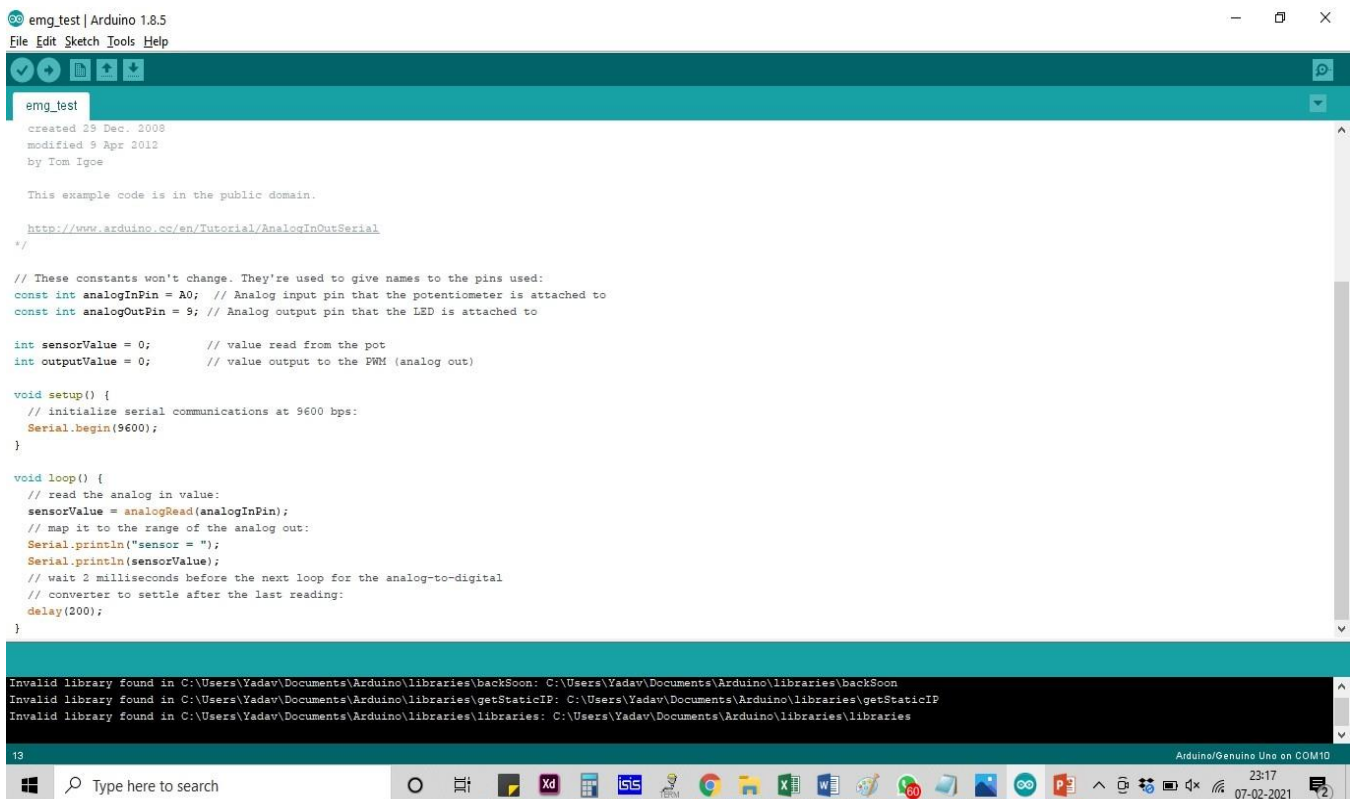
The servo motor is used extensively in the building of the robotic hand. The below image shows the acrylic hand servo motor integration:



Figure 6.2: Acrylic hand servo motor integration

The EMG sensor is used to effectively operate the full hand setup of the robotic hand. The below image shows the EMG sensor code used in this project:

Figure 6.3: EMG sensor code



```
emg_test | Arduino 1.8.5
File Edit Sketch Tools Help

emg_test
created 29 Dec. 2008
modified 9 Apr 2012
by Tom Igoe

This example code is in the public domain.

http://www.arduino.cc/en/Tutorial/AnalogInOutSerial
*/

// These constants won't change. They're used to give names to the pins used:
const int analogInPin = A0; // Analog input pin that the potentiometer is attached to
const int analogOutPin = 9; // Analog output pin that the LED is attached to

int sensorValue = 0; // value read from the pot
int outputValue = 0; // value output to the PWM (analog out)

void setup() {
  // initialize serial communications at 9600 bps:
  Serial.begin(9600);
}

void loop() {
  // read the analog in value:
  sensorValue = analogRead(analogInPin);
  // map it to the range of the analog out:
  Serial.println("sensor = ");
  Serial.println(sensorValue);
  // wait 2 milliseconds before the next loop for the analog-to-digital
  // converter to settle after the last reading:
  delay(200);
}

Invalid library found in C:\Users\Yadav\Documents\Arduino\libraries\backSoon: C:\Users\Yadav\Documents\Arduino\libraries\backSoon
Invalid library found in C:\Users\Yadav\Documents\Arduino\libraries\getStaticIP: C:\Users\Yadav\Documents\Arduino\libraries\getStaticIP
Invalid library found in C:\Users\Yadav\Documents\Arduino\libraries\libraries: C:\Users\Yadav\Documents\Arduino\libraries\libraries

13 Arduino/Genuino Uno on COM10
Type here to search 23:17 07-02-2021
```

The EMG sensor is fixed to the hand to effectively achieve the signals for movement of the hand. The below image shows the EMG sensor fixed to the user hand:

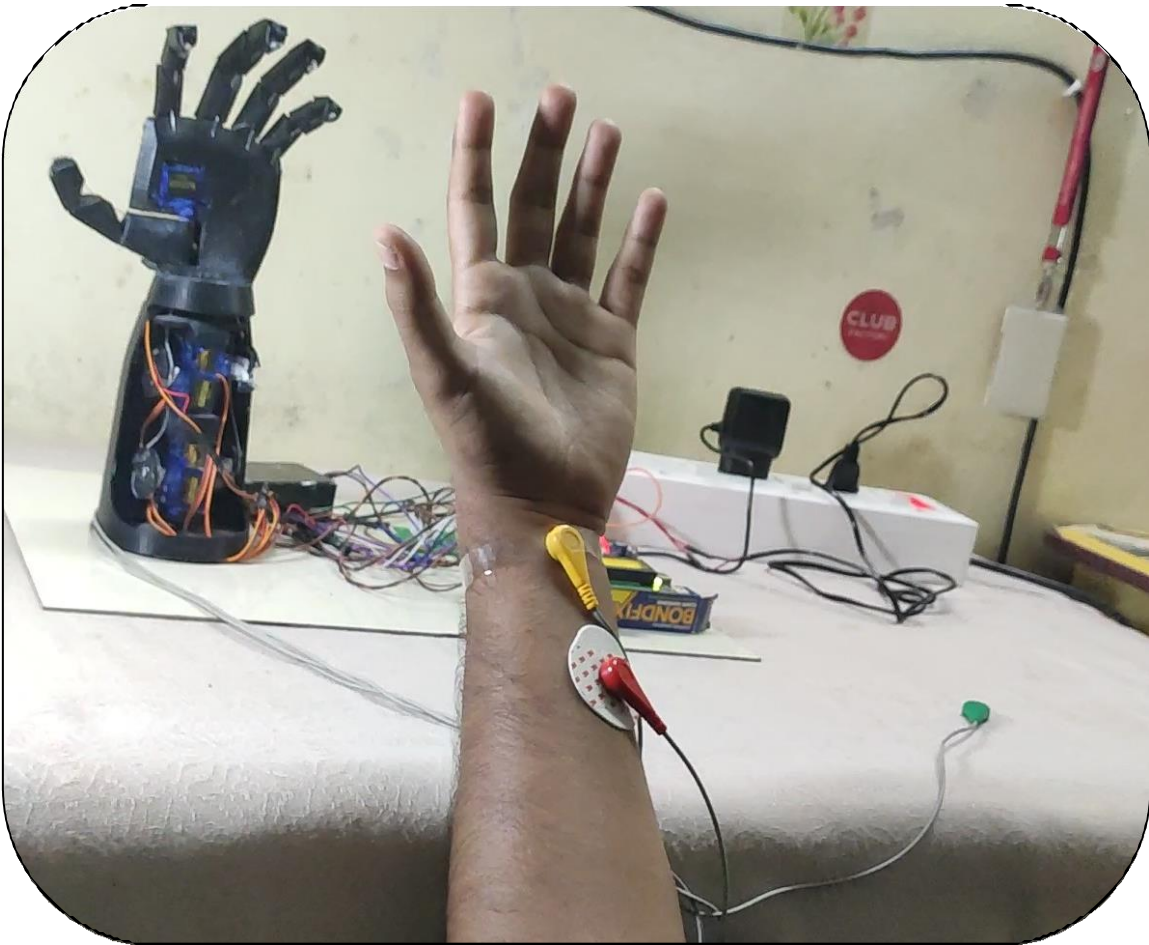
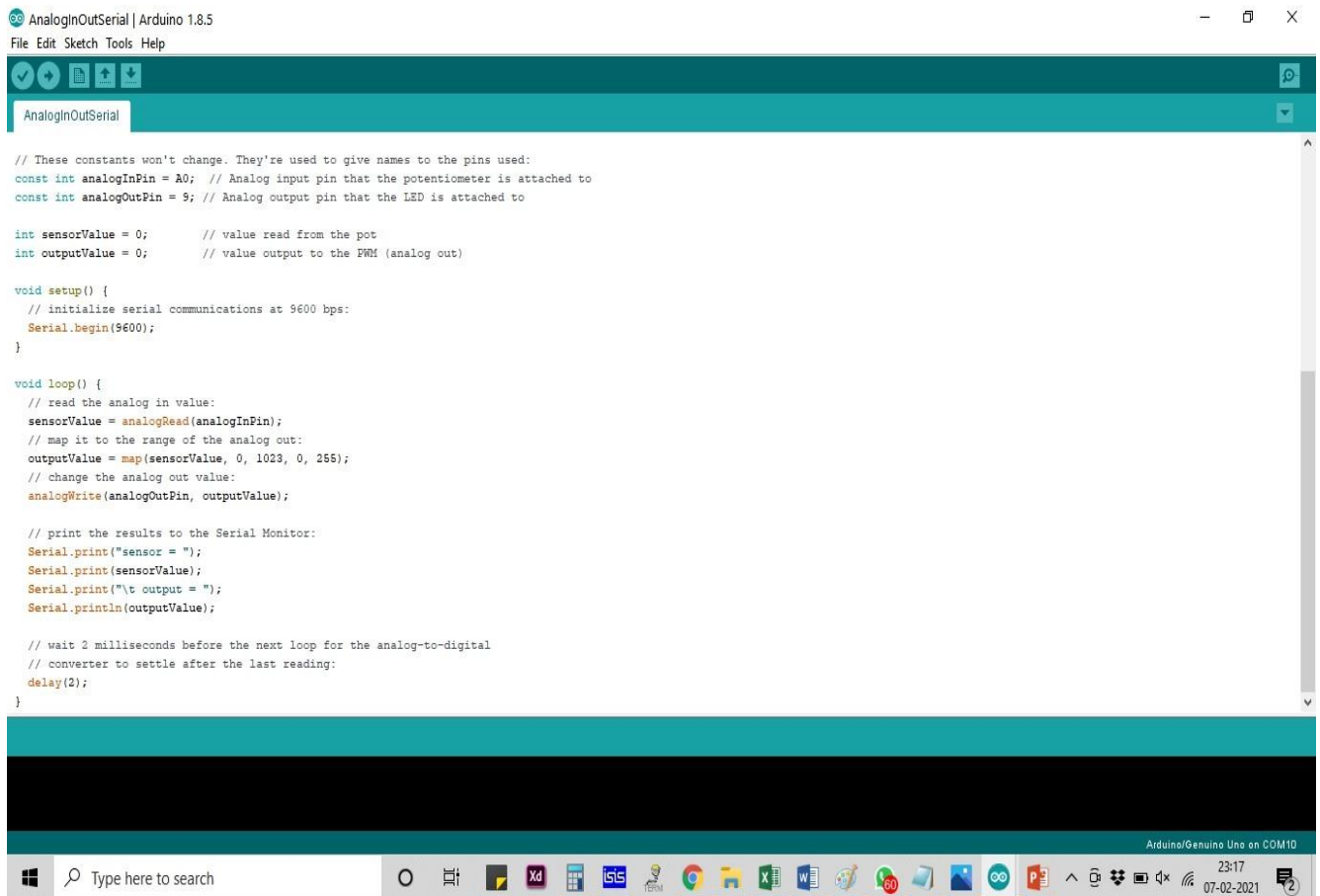


Figure 6.4: EMG sensor fixed to hand of the user

The flex sensor is used to effectively control a single finger of the robot. The below image shows the flex sensor code

Figure 6.5: Flex sensor code



```
// These constants won't change. They're used to give names to the pins used:
const int analogInPin = A0; // Analog input pin that the potentiometer is attached to
const int analogOutPin = 9; // Analog output pin that the LED is attached to

int sensorValue = 0; // value read from the pot
int outputValue = 0; // value output to the PWM (analog out)

void setup() {
  // initialise serial communications at 9600 bps:
  Serial.begin(9600);
}

void loop() {
  // read the analog in value:
  sensorValue = analogRead(analogInPin);
  // map it to the range of the analog out:
  outputValue = map(sensorValue, 0, 1023, 0, 255);
  // change the analog out value:
  analogWrite(analogOutPin, outputValue);

  // print the results to the Serial Monitor:
  Serial.print("sensor = ");
  Serial.print(sensorValue);
  Serial.print("\t\t output = ");
  Serial.println(outputValue);

  // wait 2 milliseconds before the next loop for the analog-to-digital
  // converter to settle after the last reading:
  delay(2);
}
```

The below image shows the single finger operation of the robotic hand using the flex sensor:



Figure 6.6: Single finger operation using the robotic hand.

The below image shows the full hand operation of the robotic hand using the EMG sensor:

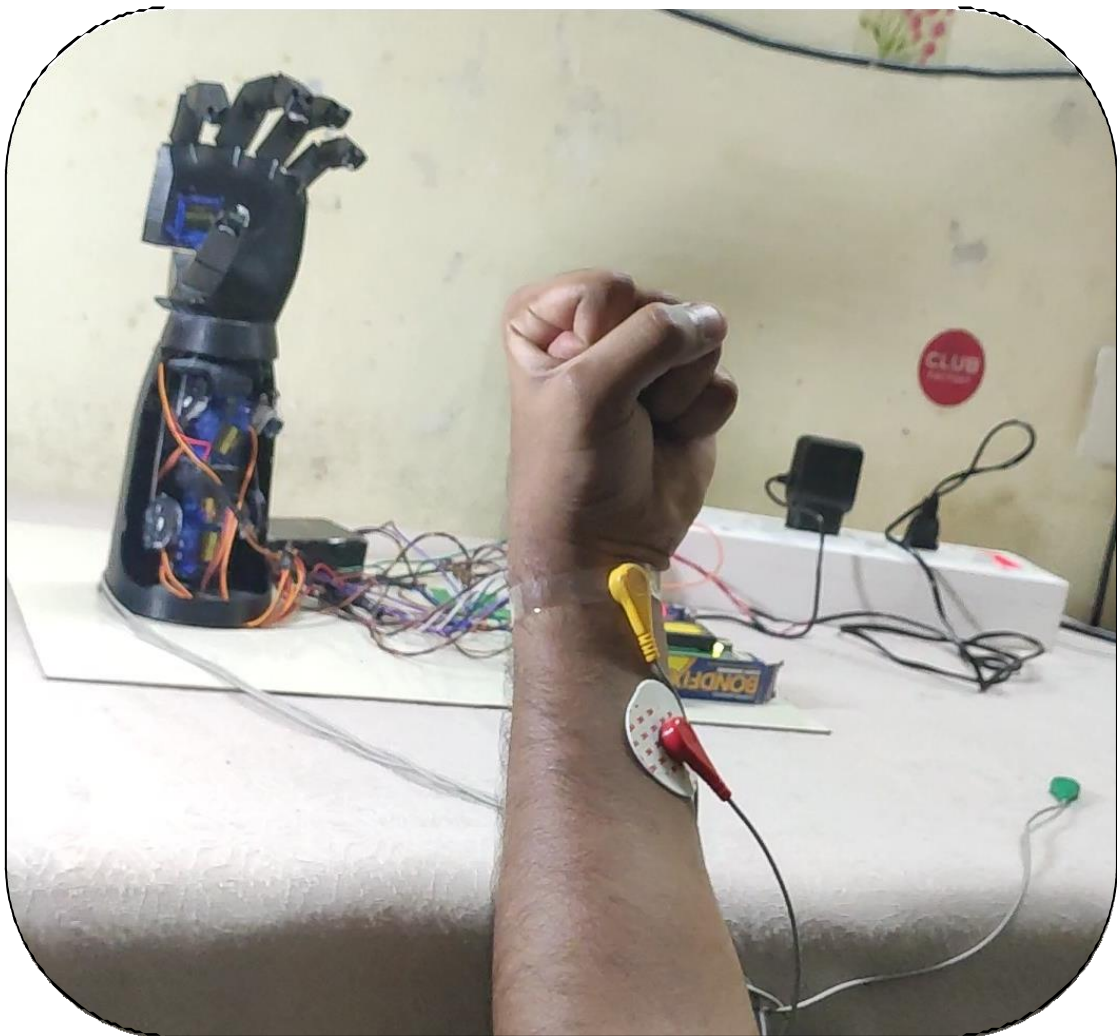


Figure 6.7: Full hand operation using the robotic hand.

Thus, from the above images it is clear the robotic hand setup has been successfully developed.

COMPARISON BETWEEN EXISTING SYSTEM AND PROPOSED SYSTEM

In the existing system, proposes a versatile soft sensing glove, using a simple process for preparing sensors of different sizes without molding. The system predominantly focuses on identifying the hand gesture movements using sensors and machine learning algorithms.

In the proposed system, I have overcome the disadvantages of the existing system by the implementation of the project using 3D printed robotic humanoid hand to mimic a human user's hand motions in a real time manner. First, the motions of the human hand are captured by a sensor .

Then the gesture of the user hand is passed to an Arduino. Finally, the microcontroller sends the control to wireless sensor networks. Then the original motion of the hand is decoded at the receiver section then the correspond in action is carried at the developed robotic arm.

The commands to the servomotors of the robotic hand to implement the required gesture.

FACTORS	EXISTING SYSTEM	PROPOSED SYSTEM
ALGORITHM	BIOMECHANICAL SENSORS	3D printed robotic humanoid
ACCURACY	Very low compared to other state-of-art methods	Has very high accuracy
COST	The system is very expensive.	The system is cheap and effective.
APPLICATION	The method is applicable only for identifying the gestures from the human hand	The method is applicable in to help a handless person to regain his hand using a robotic hand.

CHAPTER – 7

CONCLUSION AND FUTURE WORK

CONCLUSION

This project is successfully implemented to effectively enable an arm less person to get back to using his hands using a robotic humanoid hand . This project gives hope to arm less and paralyzed people to get back to using their arms back getting them back to normal.

FUTURE WORK

In the coming future, we review the application of the humanoid robotic arm in the manufacturing field such as welding, material handling, and thermal spraying, to painting and drilling and it can promote for advancement of the manufacturing technology with more accuracy. In this field, there are more chance to develop or convert this project in many ways. Thus, this project has an efficient scope in coming future where this idea can be converted to computerized production in a cheap way.

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