**cWHEELCHAIR MOVEMENT CONTROL WITH TONGUE DRIVE ASSISTIVE TECHNOLOGY USING IOT**

### A PROJECT REPORT

***Submitted by***

|  |  |
| --- | --- |
| **ABINAYAA.A** | **210918106003** |
| **DIMPLE VINCIA SELET R.R** | **210918106015** |
| **KAVITHA SRI.G** | **210918106032** |

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# ANNA UNIVERSITY: CHENNAI 600025



## BONAFIDE CERTIFICATE

Certified that this project report **“WHEELCHAIR MOVEMENT CONTROL WITH TONGUE DRIVE ASSISTIVE TECHNOLOGY USING IOT”** is the bonafide work of **“ABINAYAA.A (210918106003), DIMPLE VINCIA SELET R.R (210918106015)** and **KAVITHA SRI.G (210918106032)”** who carried out the project work under my supervision.

|  |  |
| --- | --- |
| **SIGNATURE** | **SIGNATURE** |
| DR. K.R.SHANTHY Ph.D.,  **HEAD OF THE DEPARTMENT**  Electronics And Communication Engineering  Loyola Institute of Technology Chennai -600123 | DR. K.R.SHANTHY Ph.D., **SUPERVISOR**  PROFESSOR  Electronics And Communication Engineering  Loyola Institute of Technology Chennai -600123 |

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# ABSTRACT

Tongue Drive system (TDS) is a tongue-operated unobtrusive wireless assistive technology, which can potentially provide people with severe disabilities. People with tetraplegia often use multiple devices. In Tongue Drive System it translates the users intentions into control commands by detecting and classifying their voluntary tongue motion utilizing a small permanent magnet, secured on the tongue. Array of magnetic sensors mounted on a headset outside the mouth and orthodontic brace inside. The average task completion time for wheelchair driving was 8.2% less compared to the previous studies. This would provide the user with a smooth proportional control as opposed to a switch based on/off control that is the basis of most existing technologies. The advantage of this technology is the possibility of capturing a large variety of tongue movements by processing a combination of sensor outputs. The effects of position and orientation of the permanent magnet on the sensors. The results showed that all subjects could easily operate the Powered Wheelchair Control using their tongue movements, and different control strategies worked better depending on the users familiarity with the Tongue Drive System. We have to developed customized interface circuitry and implemented four control strategies to drive a Powered Wheel Chair.

**Keywords** -Tongue drive system (TDS), RF communication.

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# LIST OF ABBREVIATIONS

* + - * **TDS** Tongue Drive System
      * **TTL** Transistor Transistor Logic
      * **PWC** Powered Wheel Chair
      * **RF** Radio Frequency
      * **RFID**  Radio Frequency Identification
      * **EPC**  Electronic Product Code

# CHAPTER 1

## INTRODUCTION

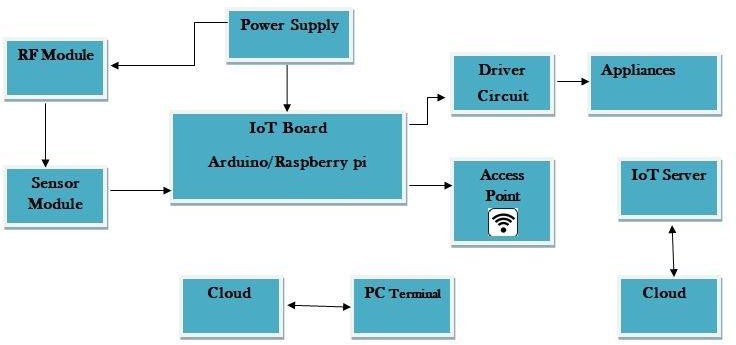
The paper aims in designing customized interface circuitry by implementing four control strategies to move a wheel chair. TDS is an assistive technology that enables individuals to maneuver a wheelchair using simple tongue movements and it can be operated by individuals. The purpose of the present study is to develop a wheel chair for the Quadriplegics which assists them to control the movement of wheelchair through their tongue motion using a Hall effect sensors with encoder and decoder for controlling it safely. The magnetic sensors are nothing but hall effect sensors. A hall effect sensor is a transducer that varies its output voltage in response to changes in magnetic field and there is no need for any human intervention. The magnetic sensors are nothing but hall-effect sensors. A Hall Effect sensor is a transducer that varies its output voltage in response to changes in magnetic field. In its simplest form, the sensor operates as an analogue transducer, directly returning a voltage. With a known magnetic field, its distance from the Hall plate can be determined. Tongue movements are also fast, accurate and do not require much thinking, concentration or effort. Movement of the magnetic tracer attached to the tongue is detected by an array of magnetic field sensors mounted on a headset outside the mouth or on an orthodontic brace inside the mouth. The sensor output signals are wirelessly transmitted to a portable computer, which can be carried on the user's clothing or wheelchair. The sensor output signals are processed to determine the relative motion of the magnet with respect to the array of sensors in real-time.

## INTERNET OF THINGS (IOT)

The Internet of Things (IOT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Typically, IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine communications (M2M) and covers a variety of protocols, domains, and applications.[ The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a Smart Grid.

Things, in the IOT, can refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, or field operation devices that assist fire-fighters in search and rescue. Current market examples include thermostat systems and washer/dryers that utilize wifi for remote monitoring. According to Gartner, Inc. (a technology research and advisory corporation), there will be nearly 26 billion devices on the Internet of Things by 2020. ABI Research estimates that more than 30 billion devices will be wirelessly connected to the Internet of Things (Internet of Everything) by 2020.

As per a recent survey and study done by Pew Research Internet Project, a large majority of the technology experts and engaged Internet users who responded—83 percent—agreed with the notion that the Internet/Cloud of Things, embedded and wearable computing (and the corresponding dynamic systems ) will have widespread and beneficial effects by 2025. It is, as such, clear that the IOT will consist of a very large number of devices being connected to the Internet.



BLOCK DIAGRAM OF IOT

Integration with the Internet implies that devices will utilize an IP address as a unique identifier. However, due to the limited address space of IPv4 (which allows for 4.3 billion unique addresses), objects in the IOT will have to use IPv6 to accommodate the extremely large address space required. Objects in the IOT will not only be devices with sensory capabilities, but also provide actuation capabilities (e.g., bulbs or locks controlled over the Internet). To a large extent, the future of the Internet of Things will not be possible without the support of IPv6; and consequently the global adoption of IPv6 in the coming years will be critical for the successful development of the IOT in the future.

The embedded computing nature of many IOT devices means that low- cost computing platforms are likely to be used. In fact, to minimize the impact of such devices on the environment and energy consumption, low-power radios are likely to be used for connection to the Internet. Such low-power radios do not use WIFI, or well established Cellular Network technologies, and remain an actively developing research area. However, the IOT will not be composed only of embedded devices, since higher order computing devices will be needed to perform heavier duty tasks (routing, switching, data processing, etc.). Companies such as Free Wave Technologies have developed and manufactured low power

wireless data radios (both embedded and standalone) for over 20 years to enable Machine-to-Machine applications for the industrial internet of things

Besides the plethora of new application areas for Internet connected automation to expand into, IOT is also expected to generate large amounts of data from diverse locations that is aggregated and very high-velocity, thereby increasing the need to better index, store and process such data. Diverse applications call for different deployment scenarios and requirement, which have usually been handled in a proprietary implementation. However, since the IOT is connected to the Internet, most of the devices comprising IOT services will need to operate utilizing standardized technologies. Prominent standardization bodies, such as the IETF, IPSO Alliance and ETSI, are working on developing protocols, systems, architectures and frameworks to enable the IOT

## FUNCTIONING OF INTERNET OF THINGS (IOT)

## INTRODUCTION

The Internet of Things is the expansion of the current Internet services so as to accommodate each and every object which exists in this world or likely to exist in the coming future. This article discusses the perspectives, challenges and opportunities behind a future Internet that fully supports the “things”, as well as how the things can help in the design of a more synergistic future Internet. Things having identities and virtual personalities operating in smart spaces using intelligent interfaces to connect and communicate within social, environmental, and user contexts. There are several fuzziness about the concept of Internet of Things such as IOT can be broken in two parts.

The worldwide network of interconnected computer networks based on a standard communication protocol, the Internet suite (TCP/IP) while a things is an object not precisely identifiable. The world around us is full of objects, smart objects and the existing service provider known as Internet. The convergence of the sensors like smart objects, RFID based sensor networks and Internet gives rise to the Internet of Things. With increased usage of sensors the raw data as well as distributed data is increasing. Smart devices are now connected to Internet using their communication protocol and continuously collecting and processing the data.

Ubiquitous computing which was thought as a difficult task has now become a reality due to advances in the field of Automatic Identification, wireless communications, distributed computation process and fast speed of Internet . From just a data perspective the amount of data generated, stored and processed will be enormous. We focused on making this architecture as a sensor based architecture where each sensor node will be as important as the sensor network itself. Visualizing each sensor as having intelligence is the ultimate aim of any architecture in the IOT domain.

There is a lot of pervasive presence in the human environment of things or objects, described general overview of internet evolution with several IOT services with the use of radio-frequency identification (RFID) tags, sensors, actuators, mobile phones, smart embedded devices, etc. – which, through unique addressing schemes, are able to effectively communicate and interact with each other and work together to reach a common goal of making the system easier to operate and utilize. The objects that will be connected will be adaptive, intelligent, and responsive.

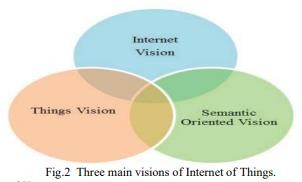
### FUTURE VISION OF INTERNET OF THINGS

The Internet of Things is a vision which is under development and there can be many stake holders in this development depending upon their interests and usage. It is still in nascent stages where everybody is trying to interpret IOT in with respect to their needs. Sensor based data collection, data management, data mining and World Wide Web is involved in the present vision. Of course sensor based hardware is also involved. A simple and broad definition of the internet of things and the basic idea of this concept is the pervasive presence around us of a variety of things or objects – such as Radio-Frequency Identification (RFID) tags, sensors, actuators, mobile phones, etc. – which, through unique addressing schemes, are able to interact with each other and cooperate with their neighbors to reach common goals. The three particular visions given by

* + - * Things Oriented Vision
      * Internet Oriented Vision
      * Semantic Oriented Vision

### Things Oriented Vision

This vision is supported by the fact that we can track anything using sensors and pervasive technologies using RFID. The basic philosophy is uniquely identifying any object using specifications of Electronic Product Code (EPC) .This technique is extended using sensors. It is important to appreciate the fact that future vision will depend upon sensors and its capabilities to fulfill the “things” oriented vision. We will be able to generate the data collectively with the help of sensors, and sensor type embedded system. The summarized vision will be dependent upon sensor based networks as well as RFID-based Sensor Networks which will take care of the integration of technology based on RFID and sophisticated sensing and computing devices and the global connectivity.



### Internet Oriented Vision

The internet-oriented vision has pressed upon the need to make smart objects which are connected. The objects need to have characteristics of IP protocols as this is one of the major protocols being followed in the world of Internet. The sensor based object can be converted in to an understandable format, which can be identified uniquely and its attributes can be continuously monitored. This makes the base for smart embedded objects which can be assumed to be a microcomputers having computing resources.

### 1.2.5 Semantic Oriented Vision

This vision is powered by the fact that the amount of sensors which will be available at our disposal will be huge and the data that they will collect will be massive in nature. Thus we will have vast amount of information, possibly redundant, which needs to be processed meaningfully. The raw data needs to be managed, processed and churned out in an understandable manner for better representations and understanding. If we are able to make the sets of data into homogeneous and heterogeneous formats then the interoperability issues of understanding the data will be dependent upon the semantic technologies to process the data. It is here that needs a generic vision of processing the raw data in to meaningful data and a marked separation of data and their interpretation.

This is a meaningful inferences to develop a unified picture of the situation for smart applications. This is possible through large scale sensor networks, data processing and inferences using smart sensing and cloud computing. The inferences will make the sensors sensible enough to rectify the whole process which in turn will move towards making the whole process intelligent. The components that make up the WSN monitoring network include:

* **Wireless Sensor Networks hardware** - Typically a WSN node contains interfaces to sensors, computing and processing units, transceiver units and power supply. More sophisticated sensor nodes can communicate over multiple frequencies
* **Wireless Sensor Networks Communication Stack (WSNCS)** – The nodes will be deployed in an adhoc manner. Communication topology will be an important factor for communication through the system of WSN nodes. There is this communication stack at one central node which will be able to interact with the connected world through the Internet and which will act as a gateway to the WSN subnet and the Internet .
* **Middleware**–This is associated with the internet infrastructure and the concept of service oriented architecture (SOA) for access to heterogeneous sensor resources as described in. WSNs technological advances in hardware domain catering to circuits and wireless communications have made robust and cost effective devices in sensing applications. This has led to the use of sensors in wireless communication devices in diversified environments. Sensor data is collected and sent for centralized, distributed or any hybrid processing module for data processing. Hence, there are several challenges WSN has to face to develop a successful IOT communication networks.

## 1.2.6 Communication Mechanism

6lowpan Challenges all the objects that are present in the environment can be called object fit to be the “things” of the internet. All these objects need an address which must be unique. This uniqueness property will be a unique constraint and it will pave the way to gather information and even control sensor based devices. Internet Protocol is the standard based protocol which is used for internetworking methods of Internet. The first version was IPv4 and was thought of having huge address spaces. But IPv4 got exhausted. smart embedded devices or simply a sensor. Their communication mechanisms will be WiFi, DSL, Satellite, Cable, Ethernet and so forth. The typical packet size of the communicating protocol will be around 1500 data bytes to 9000 data bytes and even more. Today large amount of spatial data is also being generated and thus we can use to use metadata for connecting database and Internet. As happens in World Wide Web, the operations with sensor nodes may not be possible by giving unique names to the sensors. Instead a unique address scheme must be formulated and will be known as Unique Resource Name (URN).A look up table of these URN must be present at the centralized node commonly known as gateway to the sensor sub system. Thus entire network now forms a web of connectivity from users (high-level) to sensors (low-level) that is addressable (through URN) accessible (through URL) and controllable (through Uniform Resource Characteristics - URC) [11]

* **Data Storage** - As IOT is getting developed the amount of data getting created is huge. The data centers which will be storing this data will also needs space requirement as well as the energy and power resources. It is this data which needs to be organized and processed. Semantic data fusion models will also be required to create meaning out of this data. Artificial Intelligence algorithms must be applied to

extract meaning from this redundant data. Data storage and analysis will be a challenge when the whole world will be connected through IOT.

* **Visualization** - Any interaction of user with the environment will need proper visualization software which will highlight the sensing mechanism as well the interpretation of data scenario too. Touch screens and smart embedded tablets have created a conductive environment for the system. The information which is being processed in to meaningful data using sensor fusion algorithms will present lot many inferences about the current situation.

### IOT : SERVICES AND APPLICATIONS

Let us look into the possible set of future possibilities which we can have a rewarding applications. Some of the attributes which can be considered while developing application is highlighted in which says the network availability, bandwidth, area of coverage, redundancy, user involvement and impact analysis. Fig.7 mainly focuses on the properties of the RFID, sensors and 6lowpan communication networks based IoT services.

### Tracking:

People, Inventory and Logistic The basis of this tracking is indeed RFID tags which are placed on object, human beings, animals, logistics etc. RFID tag reader may be used in all the intermediate stages for tracking anything which has the RFID tag in it. This object position identification can be smartly used to trigger an alarm, event or a specific inference regarding a specific subject.

### Smart Environment and Enterprise Collection

In any work environment an enterprise based application can come up with the fact that it is based on smarter environment. Here the individual or the enterprise may give data to outside world on its own discretion. Smart embedded sensor technology can be used in order to monitor and transmit critical parameters of the environment. Common attributes of the environment are temperature, humidity, pressure etc. Smart monitoring of soil parameters can allow informed decision making about agriculture and increase production of food grains and prevent loss of crops . Water conservation is huge topic of concern where droughts are frequent. To limit water wastage, smart technology can be used in water conservation.

### Smart Unit

Another IOT application which is making waves is the Smart grid and smart metering technology. The energy consumption can be efficiently monitored in a smart home or in a small office or even a locality. This model can be extended over a city for better load balancing. The world is fast changing and now camera based surveillance is high in demand. This surveillance will not only require image processing but also computer vision. IOT which will be based on video processing is a new technological challenge to integrate large computation with small embedded device. Smart homes can be developed where things of daily use will be tracked using sensor enabled technologies.

### Local, Global and Social Sensing

Imagine a scenario where each of the family members of the family have a RFID enabled gadget and thus object tracking can result actually in human tracking. This can readily happen in IoT where common mobile phones can be used for tracking human beings. There can be various types of sensors based devices which can be used for such type of tracking. This is whole process is known as local, global and social sensing. The object can be tracked locally, globally and in any place, any time and over any network.

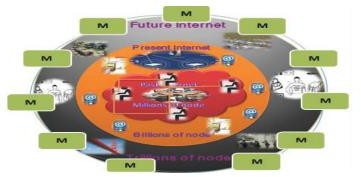
### Healthcare Monitoring Applications

Imagine a scenario in a village where old age persons, infants, pregnant ladies etc. have RFID enabled chips over their bodies to track their vital health parameters. Any unusual activity on their part will raise an alarm or an alert in the nearby local medical assistance home. For example, RFID chips can be implanted in patients in order to track their medical history. Sensor technology can be used in emergency response, and health monitoring applications. The information can be used to give medical assistance to the needful person and in case of higher abnormalities, the nearby efficient hospitals can be alerted and thus the hospitalization costs can be reduced through early intervention and treatment. This is the advantage of smart healthcare using IOT.

### Traffic Monitoring

In any city in the world, traffic monitoring is an important part of the smart-city infrastructure. Normal traffic to highway traffic all requires adequate information about the support and logistics available on the highway and in turn the system can be made self-reliable and intelligent. Any type of congestion on roads will ultimately lead to loss of fuel and economic loss. Any foresight on traffic will always help to improve the whole system. With number of WSN and Sensor enabled communications, an IOT of traffic will be generated.

This will be known as Traffic IOT (TIOT). The information collected from TIoT can be presented to travelers. The traffic information will be dependent upon the queuing model on roads and infrastructure of roads itself. This identification of critical road points and present state of traffic information on all roads can be provided to the user. However this traffic monitoring application needs to be secure to prevent any terrorist attack frequent in urban cities.



## Benefits of IOT

The internet of things offers a number of benefits to organizations, enabling them to:

* Monitor their overall business processes.
* Improve the customer experience.
* Save time and money.
* Enhance employee productivity.
* Integrate and adapt business models.
* Make better business decisions.
* Generate more revenue.

## CHAPTER 2 LITERATURE SURVEY

* 1. **Wireless Control of Powered Wheelchairs With tongue motion using Tongue drive assistive Technology**

**AUTHORS:** D. Naga Bramhendra , K. Mallikarjuna

**Published in :** 2012 International Journal of Electronics Communication and Computer Engineering .

Our ultimate goal in developing the TDS is to help people with severe disabilities experience and preserve an independent, self-supportive life. The system uses an array of magnetic sensors to wirelessly track tongue movements by detecting the position and orientation of a permanent magnetic tracer secured on the tongue. The tongue movements can then be translated into various commands for computer access, navigation, or environment control. The current external TDS prototype consists of four magneto-inductive sensors mounted on a face Helmet Laboratory-based human trials on six nondisabled male subjects have demonstrated that the present TDS prototype can help users potentially substitute some of their lost arm and hand functions with tongue movements when accessing a wheel chair by movement of the magnet which is placed on the tongue.

## An Independent Tongue-Operated Assistive System for both Access and Mobility

**AUTHORS:** Nazmus Sahadat, Shreyas Dighe, Fatima Islam, and Maysam Ghovanloo

This work presented a new independent TDS prototype based on an open-source embedded platform which makes it independent of PC/smartphone, visual feedback, and connecting with a wide range of devices in the user environment such as PC, smartphone, TV, IOT devices, robotic arms, and so forth. Evaluation study by fifteen novice users showed similar performance in playing a 4-command computer game (Fish Tales) in comparison to keyboard arrow keys. Three different wheelchair driving strategies were implemented, tested and compared with the default joystick controller in a constraint driving track. Latched mode of wheelchair driving was found to be the fastest and unlatched mode, the least erroneous among them.

* 1. **WIRELESS SMART WHEELCHAIR**

**AUTHOR**: Prakash Bethapudi

The main aim of this project implementation is to help all the people who are dependent on wheelchair for their mobility. Wheelchair is simple to operate and does not need any external help. The objectives of this project have been achieved successfully. This project was able to develop an android system that can control the movement of the wheelchair. This is an design of android application that can direct the movement of a wheelchair, to develop the movement mode which help the elder lies and physically disabled people to move their wheelchairs independently and to provide the elder lies and physically disabled people with the ability to control the movement of the wheelchairs by using android smart phones. The  
system designed has undergone a few tests and successfully completed the basic performance. The objectives were achieved as the software and hardware implementation work well as expected. This system will helps the elderlies and physically disabled people to control wheelchairs by themselves; therefore this success is to serve many people with disabilities. From the conducted research, it can be seen clearly that a mobile controlled wheelchair will have a bright future. It should be continued and developed in the future as it has a huge potential to improve its performance, reliability and safety.

**2.4 Control Systems and Electronic Instrumentation  
Applied to Autonomy in Wheelchair Mobility**

**AUTHORS :** Mauro Callejas-Cuervo, Aura Ximena González-Cely and Teodiano Bastos-Filho

The control systems developed between 2012 and 2019 include implementations which are non-invasive for the user, delving into BCI, given that there are more works related to this topic. Furthermore, HMI makes it more interactive and allows the system to relate to the user’s everyday life. In addition, artificial intelligence is contributing to this field by developing interfaces that permit the controlled system to make decisions regarding the person’s mobility. This work also contributes with the number of participants who validate the instrumented and controlled system of the completed wheelchair or prototype. Taking into consideration that this article involves 97 documents in the range of dates established, the analysis indicates that 40% of the articles use security systems to avoid obstacles, this being a percentage that does not guarantee the safety of the patient. Besides, the most commonly used techniques involve EEG signals, head movements, the use of cameras, controls through voice patterns, AI techniques, classic controls, and the use of thresholds to determine actions in the motors of the wheelchair. Among the techniques most frequently used, controls of position, velocity and acceleration Sensors 2020, 20, 6326 21 of 27 can be found, in addition to thresholds to determine actions in the motors of the wheelchair. The authors also involve the use of neural networks so the system learns based on input data. The selection of a certain controller cannot be suggested given to the diversity of designs presented in this review, which are part of different types of instrumentations. Notwithstanding, it can be affirmed that the instrumentation with a lesser margin of error makes for a better design of controller in any area of control theory. This article indicates that the techniques that can be implemented in users with disabilities in their lower and upper limbs are EEG, sEMG, and EOG, and the rest of the techniques mentioned are useful for people with disabilities in their lower limbs only. From the point of view of the investigation, the controllers that have been developed lately involve the use of EEG, head movement, voice commands, among others. However, not all of them have security systems and they are mainly very expensive to manufacture. For this reason, building a controller that involves a robust security system based on head movements using IMU is a challenge. The implementation of these designs can improve the quality of life of people with disabilities in lower and/or upper limbs and can be used in different conditions or spaces in order to guarantee their adequate functioning and the mobility of the user.

**2.5 A STUDY ON SMART WHEELS CHAIR SYSTEMS**

**AUTHORS :** Mohammed Hayyan Al Sibai and 2Sulastri Abdul Manap

This paper presents different smart technologies for wheelchairs. It focuses on two main properties: The human - machine interface and the navigation methods and devices. Also it reviews other smart Product/seller name Specification Price Estimation Karman Full power stand up chair, 18”power wheelchair with standing function, drive mode available while in standing position, relieves pressure, promotes blood circulation, and overall health ~ 8,400 USD Wheelchair 88 4 wheel drive stairs climbing wheelchair with li-ion battery pack, able to climb stairs and slopes,durable rigid rubber tires to overcome obstacles or rough surfaces, equipped with li-ion battery, performance controller system ensures smooth operation at all times, top quality precision controller with lcd display, adjustable racing car seat with auto suspension, led head lights. ~12,500 USD Smile Rehab Ltd Controlled by switch joystick or scanner, sensor options for environment & user safety, line following ability, voice confirmation of outputted commands, collision safeguard, easy to set up for multiple users, wide range of options. From the review of many published papers, it is concluded that researchers are continuously trying to build a powerful and helpful wheelchairs to ease the daily life activities and to give more independent mobility for people with different types of disabilities. Unfortunately there are very few commercialized wheelchairs with the smart technology available. One reason is because the robustness and safety of the technology is not 100% guaranteed yet in many researches. However, the main reason is maybe related to marketing and feasibility issues. Using high-tech smart wheel chairs depends on the severity of the disability, the individual’s overall morale and attitude towards his or her condition and the most important is the price of the technology. Moreover, smart wheelchairs are complicated for many users. Therefore familiarization and training sessions are needed as after sales services. This makes the investment in smart wheelchairs less interesting for stockholders. Future work should maybe focus more on the add-on approach which gives flexibility in configurations of sensors, interface, and input devices based on each individual user’s need s and budget. Other options for making the wheelchair friendlier can be added in future also. For example, entertainment and social communication facilities might be added to the wheelchair. Health monitoring, first aid, muscle relaxing and rehabilitation tools might be considered as useful add-ons too.

# CHAPTER 3

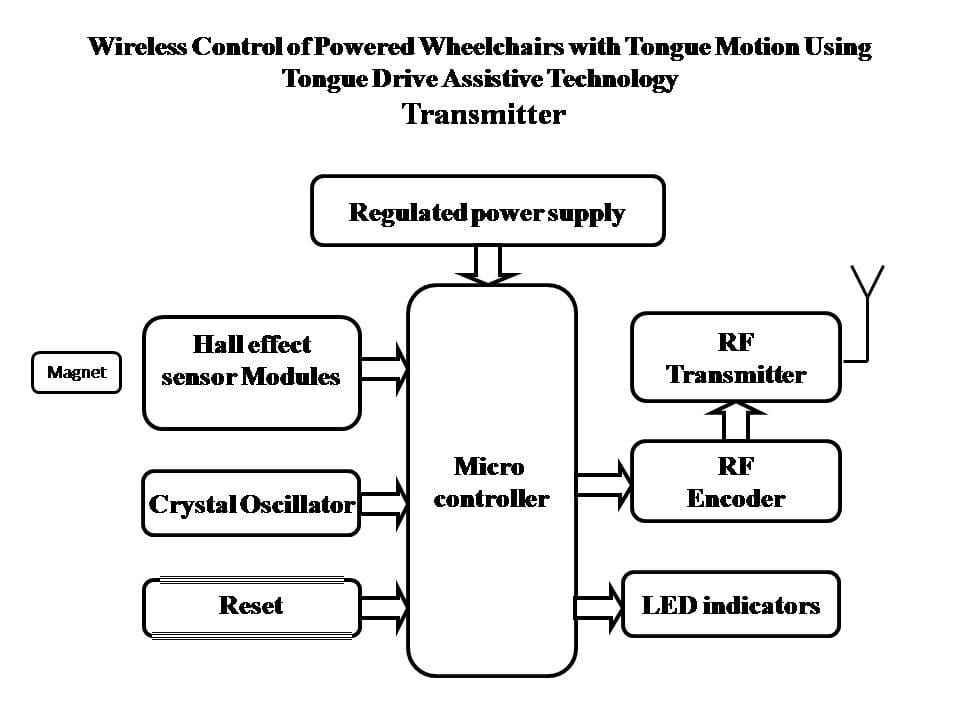
## EXISTING SYSTEM

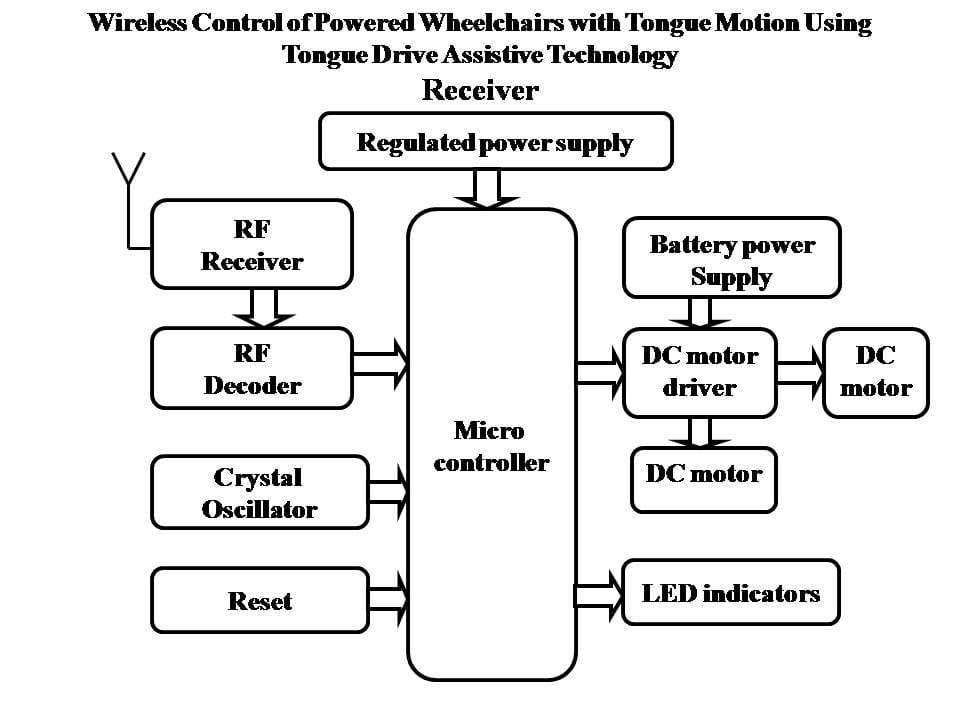
* This system uses an array of magnetic sensors to wirelessly track tongue movements by detecting the position and orientation of a permanent magnetic tracer secured on the tongue.
* The tongue movements can be translated into various commands for computer access, navigation.
* Tongue drive system (TDS) is to help people with severe disabilities and provide them an independent life.
* The current Tongue Drive System prototype consists of four magneto-inductive sensors mounted on a helmet that have been demonstrated.

## PROPOSED SYSTEM

* Tongue Drive system (TDS) is a tongue-operated unobtrusive wireless assistive technology, which can potentially provide people with severe disabilities.
* It translates users intentions into control commands by detecting and classifying their voluntary tongue motion utilizing a small permanent magnet, secured on the tongue, and an array of magnetic sensors mounted on a headset outside the mouth and orthodontic brace inside.
* We have developed customized interface circuitry and implemented four control strategies to drive a powered wheel chair (PWC) using an external TDS prototype.
* This Project consists of two Microcontroller Units, Wheel chair and Hall Effect sensors and wireless communication through RF. Wheel chair is made up of High torque Geared DC Motors, the Motors Directions can be changed through the set of instructions given from the microcontroller and the action of these Instructions is already loaded into the Microcontroller using Embedded C programming.

**3.3** **BLOCK DIAGRAM**

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## HARDWARE REQUIREMENTS

* Regulated Power Supply
* Hall Effect Sensors
* Microcontroller
* RF Transmitter
* RF Receiver
* Motor driver
* High Torque Geared DC Motors

## SOFTWARE REQUIREMENTS

* Keil µ Vision5 software for embedded C programming.
* Emulator for dumping code.

# CHAPTER 4

**HARDWARE AND SOFTWARE DESCRIPTIONS**

## REGULATED POWER SUPPLY

A **regulated power supply** is an embedded circuit; it converts unregulated AC (Alternating Current) into a constant DC. With the help of a rectifier it converts AC supply into DC. Its function is to supply a stable voltage (or less often current), to a circuit or device that must be operated within certain power supply limits. The output from the regulated power supply may be alternating or unidirectional, but is nearly always DIRECT CURRENT. The type of stabilization used may be restricted to ensuring that the output remains within certain limits under various load conditions, or it may also include compensation for variations in its own supply source. A **bench power supply** usually refers to a [power supply](https://en.wikipedia.org/wiki/Power_supply) capable of supplying a variety of output voltages useful for BE ([bench testing](https://en.wikipedia.org/w/index.php?title=Bench_testing&action=edit&redlink=1)) electronic circuits, possibly with continuous variation of the output voltage, or just some preset voltages. Some have multiple selectable ranges of current/voltage limits which tend to be [anti-proportional](https://en.wikipedia.org/wiki/Proportionality_(mathematics)#Inverse_proportionality). A laboratory ("lab") power supply normally implies an accurate bench power supply, while a balanced or tracking power supply refers to twin supplies for use when a circuit requires both positive and negative supply rails.

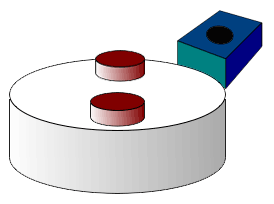


## HALL EFFECT SENSOR

A **Hall effect sensor** is a type of [sensor](https://en.wikipedia.org/wiki/Sensor) which detects the presence and magnitude of a [magnetic field](https://en.wikipedia.org/wiki/Magnetic_field) using the [Hall effect](https://en.wikipedia.org/wiki/Hall_effect). The output [voltage](https://en.wikipedia.org/wiki/Voltage) of a Hall sensor is directly proportional to the strength of the field. It is named for the American physicist [Edwin Hall](https://en.wikipedia.org/wiki/Edwin_Hall).

Hall sensors are used for [proximity sensing](https://en.wikipedia.org/wiki/Proximity_sensing), [positioning](https://en.wikipedia.org/wiki/Positioning_(navigation)), [speed detection](https://en.wikipedia.org/wiki/Speed_limit_enforcement), and [current sensing](https://en.wikipedia.org/wiki/Current_sensing) applications.[[2]](https://en.wikipedia.org/wiki/Hall_effect_sensor#cite_note-ramsden-2) Frequently, a Hall sensor is combined with threshold detection to act as a binary [switch](https://en.wikipedia.org/wiki/Switch). Commonly seen in industrial applications such as the pictured [pneumatic cylinder](https://en.wikipedia.org/wiki/Pneumatic_cylinder), they are also used in consumer equipment; for example, some [computer printers](https://en.wikipedia.org/wiki/Computer_printer) use them to detect missing paper and open covers. Some 3D printers use them to measure filament thickness.

Hall sensors are commonly used to time the speed of wheels and shafts, such as for [internal combustion engine](https://en.wikipedia.org/wiki/Internal_combustion_engine) [ignition timing](https://en.wikipedia.org/wiki/Ignition_timing), [tachometers](https://en.wikipedia.org/wiki/Tachometer) and [anti-lock braking systems](https://en.wikipedia.org/wiki/Anti-lock_braking_system). They are used in [brushless DC electric motors](https://en.wikipedia.org/wiki/Brushless_DC_electric_motor) to detect the position of the permanent magnet. In the pictured wheel with two equally spaced magnets, the voltage from the sensor peaks twice for each revolution. This arrangement is commonly used to regulate the speed of [disk drives](https://en.wikipedia.org/wiki/Disk_storage).



## MICROCONTROLLER

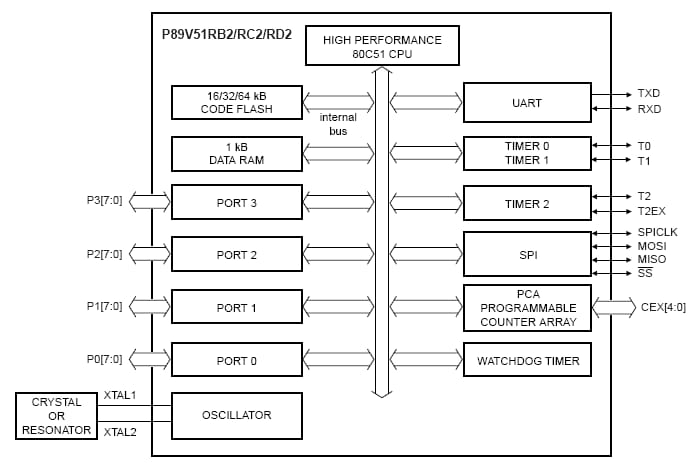
The A **microcontroller** (**MCU** for *microcontroller unit*) is a small [computer](https://en.wikipedia.org/wiki/Computer) on a single [metal-oxide-semiconductor](https://en.wikipedia.org/wiki/MOSFET) (MOS) [VLSI](https://en.wikipedia.org/wiki/VLSI) [integrated circuit](https://en.wikipedia.org/wiki/Integrated_circuit) (IC) chip. A microcontroller contains one or more [CPUs](https://en.wikipedia.org/wiki/Central_processing_unit) ([processor cores](https://en.wikipedia.org/wiki/Processor_core)) along with [memory](https://en.wikipedia.org/wiki/Computer_memory) and programmable [input/output](https://en.wikipedia.org/wiki/Input/output) peripherals. Program memory in the form of [ferroelectric RAM](https://en.wikipedia.org/wiki/Ferroelectric_RAM), [NOR flash](https://en.wikipedia.org/wiki/Flash_memory#NOR_flash) or [OTP ROM](https://en.wikipedia.org/wiki/Programmable_read-only_memory) is also often included on chip, as well as a small amount of [RAM](https://en.wikipedia.org/wiki/Random-access_memory). Microcontrollers are designed for [embedded](https://en.wikipedia.org/wiki/Embedded_system) applications, in contrast to the [microprocessors](https://en.wikipedia.org/wiki/Microprocessor) used in [personal computers](https://en.wikipedia.org/wiki/Personal_computer) or other general purpose applications consisting of various discrete chips.

In modern terminology, a microcontroller is similar to, but less sophisticated than, a [system on a chip](https://en.wikipedia.org/wiki/System_on_a_chip) (SoC). An SoC may connect the external microcontroller chips as the motherboard components, but an SoC usually integrates the advanced peripherals like [graphics processing unit](https://en.wikipedia.org/wiki/Graphics_processing_unit) (GPU) and [Wi-Fi](https://en.wikipedia.org/wiki/Wi-Fi) interface controller as its internal microcontroller unit circuits.

Microcontrollers are used in [automatically controlled](https://en.wikipedia.org/wiki/Control_system) products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other [embedded systems](https://en.wikipedia.org/wiki/Embedded_system). By reducing the size and cost compared to a design that uses a separate [microprocessor](https://en.wikipedia.org/wiki/Microprocessor), memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. [Mixed signal](https://en.wikipedia.org/wiki/Mixed-signal_integrated_circuit) microcontrollers are common, integrating analog components needed to control non-digital electronic systems. In the context of the [internet of things](https://en.wikipedia.org/wiki/Internet_of_things), microcontrollers are an economical and popular means of [data collection](https://en.wikipedia.org/wiki/Data_collection), [sensing](https://en.wikipedia.org/wiki/Sensor) and [actuating](https://en.wikipedia.org/wiki/Actuator) the physical world as [edge devices](https://en.wikipedia.org/wiki/Edge_device).



* + 1. **BLOCK DIAGRAM**



**4.3.2 Description**

* The P89V51RD2 is an 80C51 microcontroller with 64 kB Flash and 1024 bytes of data RAM.
* A key feature of the P89V51RD2 is its X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (6 clocks per machine cycle) to achieve twice the throughput at the same clock frequency.
* Another way to benefit from this feature is to keep the same performance by reducing the clock frequency by half, thus dramatically reducing the EMI. The Flash program memory supports both parallel programming and in serial In-System Programming (ISP).
* Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control.
* The capability to field/update the application firmware makes a wide range of applications possible.
* The P89V51RD2 is also In-Application Programmable (IAP), allowing the Flash program memory to be reconfigured even while the application is running.
  + 1. **FEATURES**
* 80C51 Central Processing Unit
* V Operating voltage from 0 to 40 MHz
* 64 kb of on-chip Flash program memory with ISP (In-System Programming) and IAP (In-Application Programming)
* Supports 12-clock (default) or 6-clock mode selection via software or ISP
* SPI (Serial Peripheral Interface) and enhanced UART
* PCA (Programmable Counter Array) with PWM and Capture/Compare functions
* Four 8-bit I/O ports with three high-current Port 1 pins (16 mA each)
* Three 16-bit timers/counters
* Programmable Watchdog timer (WDT)
* Eight interrupt sources with four priority levels
* Second DPTR register
* Low EMI mode (ALE inhibit)
* TTL- and CMOS-compatible logic levels
  1. **Bluetooth**

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH(Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.



* + 1. **Hardware features**
* Typical -80dBm sensitivity
* Up to +4dBm RF transmit power
* Low Power 1.8V Operation ,1.8 to 3.6V I/O
* PIO control
* UART interface with programmable baud rate
* With integrated antenna
* With edge connector
  + 1. **Software Features**
* Software features Default Baud rate: 38400, Data bits:8, Stop bit:1,Parity:No parity, Data control: has. Supported baud rate: 9600,19200,38400,57600,115200,230400,460800.
* Given a rising pulse in PIO0, device will be disconnected.
* Status instruction port PIO1: low-disconnected, high-connected;
* PIO10 and PIO11 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
* Auto-connect to the last device on power as default.
* Permit pairing device to connect as default.
* Auto-pairing PINCODE:”0000” as default
* Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

## RF TRANSMITTER

In [electronics](https://en.wikipedia.org/wiki/Electronics) and [telecommunications](https://en.wikipedia.org/wiki/Telecommunications), a **radio transmitter** or just **transmitter** is an [electronic device](https://en.wikipedia.org/wiki/Electronic_device) which produces [radio waves](https://en.wikipedia.org/wiki/Radio_wave) with an [antenna](https://en.wikipedia.org/wiki/Antenna_(radio)). The transmitter itself generates a [radio frequency](https://en.wikipedia.org/wiki/Radio_frequency) [alternating current](https://en.wikipedia.org/wiki/Alternating_current), which is applied to the [antenna](https://en.wikipedia.org/wiki/Antenna_(radio)). When excited by this alternating current, the antenna radiates radio waves.

Transmitters are necessary component parts of all electronic devices that communicate by [radio](https://en.wikipedia.org/wiki/Radio_communication), such as [radio](https://en.wikipedia.org/wiki/Radio_broadcasting) and [television broadcasting](https://en.wikipedia.org/wiki/Television_broadcasting) stations, [cell phones](https://en.wikipedia.org/wiki/Cell_phone), [walkie-talkies](https://en.wikipedia.org/wiki/Walkie-talkie), [wireless computer networks](https://en.wikipedia.org/wiki/Wireless_LAN), [Bluetooth](https://en.wikipedia.org/wiki/Bluetooth) enabled devices, [garage door openers](https://en.wikipedia.org/wiki/Garage_door_opener), [two-way radios](https://en.wikipedia.org/wiki/Two-way_radio) in aircraft, ships, spacecraft, [radar](https://en.wikipedia.org/wiki/Radar) sets and navigational beacons. The term *transmitter* is usually limited to equipment that generates radio waves for [communication](https://en.wikipedia.org/wiki/Communication_engineering) purposes; or [radiolocation](https://en.wikipedia.org/wiki/Radiolocation), such as [radar](https://en.wikipedia.org/wiki/Radar) and navigational transmitters. Generators of radio waves for heating or industrial purposes, such as [microwave ovens](https://en.wikipedia.org/wiki/Microwave_oven) or [diathermy](https://en.wikipedia.org/wiki/Diathermy) equipment, are not usually called transmitters, even though they often have similar circuits.

The term is popularly used more specifically to refer to a [broadcast transmitter](https://en.wikipedia.org/wiki/Broadcast_transmitter), a transmitter used in [broadcasting](https://en.wikipedia.org/wiki/Broadcasting), as in FM radio transmitter or [television transmitter](https://en.wikipedia.org/wiki/Television_transmitter). This usage typically includes both the transmitter proper, the antenna, and often the building it is housed in.

## RF RECEIVER

In  [radio communications](https://en.wikipedia.org/wiki/Radio" \o "Radio), a **radio receiver**, also known as a **receiver**, a **wireless**, or simply a **radio**, is an electronic device that receives [radio waves](https://en.wikipedia.org/wiki/Radio_wave) and converts the information carried by them to a usable form. It is used with an [antenna](https://en.wikipedia.org/wiki/Antenna_(radio)). The antenna intercepts radio waves ([electromagnetic waves](https://en.wikipedia.org/wiki/Electromagnetic_wave) of [radio frequency](https://en.wikipedia.org/wiki/Radio_frequency)) and converts them to tiny [alternating currents](https://en.wikipedia.org/wiki/Alternating_current) which are applied to the receiver, and the receiver extracts the desired information. The receiver uses [electronic filters](https://en.wikipedia.org/wiki/Electronic_filter) to separate the desired [radio frequency](https://en.wikipedia.org/wiki/Radio_frequency) signal from all the other signals picked up by the antenna, an [electronic amplifier](https://en.wikipedia.org/wiki/Electronic_amplifier) to increase the power of the signal for further processing, and finally recovers the desired information through [demodulation](https://en.wikipedia.org/wiki/Demodulation).

Radio receivers are essential components of all systems that use [radio](https://en.wikipedia.org/wiki/Radio). The information produced by the receiver may be in the form of sound, video ([television](https://en.wikipedia.org/wiki/Television)), or [digital data](https://en.wikipedia.org/wiki/Digital_signal).[[1]](https://en.wikipedia.org/wiki/Radio_receiver#cite_note-1) A radio receiver may be a separate piece of electronic equipment, or an [electronic circuit](https://en.wikipedia.org/wiki/Electronic_circuit) within another device. The most familiar type of radio receiver for most people is a broadcast radio receiver, which reproduces sound transmitted by [radio broadcasting](https://en.wikipedia.org/wiki/Radio_broadcasting) stations, historically the first mass-market radio application. A broadcast receiver is commonly called a "radio". However radio receivers are very widely used in other areas of modern technology, in [televisions](https://en.wikipedia.org/wiki/Television), [cell phones](https://en.wikipedia.org/wiki/Cell_phone), [wireless modems](https://en.wikipedia.org/wiki/Wireless_modem), [radio clocks](https://en.wikipedia.org/wiki/Radio_clock) and other components of communications, remote control, and wireless networking systems.

## MOTOR DRIVER

**Motor drive** means a system that includes a motor. An adjustable speed motor drive means a system that includes a motor that has multiple operating speeds. A variable speed motor drive is a system that includes a motor and is continuously variable in speed. If the motor is generating electrical energy rather than using it – this could be called a generator drive but is often still referred to as a motor drive.

Sometimes this is confused with a Variable Frequency Drive(VFD) or Variable Speed Drive(VSD) which describes the electronic portion of the system that controls the speed of the motor. More generally, the term **drive**, describes equipment used to control the speed of machinery. Many industrial processes such as assembly lines must operate at different speeds for different products. Where process conditions demand adjustment of flow from a pump or fan, varying the speed of the drive may save energy compared with other techniques for flow control.

Where speeds may be selected from several different pre-set ranges, usually the drive is said to be adjustable speed. If the output speed can be changed without steps over a range, the drive is usually referred to as *variable speed*.

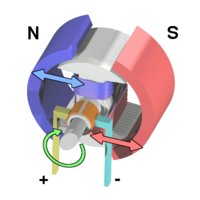
Adjustable and variable speed drives may be purely mechanical (termed *[variators](https://en.wikipedia.org/wiki/Variator" \o "Variator)*), electromechanical, hydraulic, or electronic.

Sometimes motor drive refers to a drive used to control a motor and therefore gets interchanged with VFD or VSD.

## High Torque Geared DC Motors

A **DC motor** is any of a class of rotary [electrical motors](https://en.wikipedia.org/wiki/Electrical_motor) that converts direct current (DC) electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.

DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The [universal motor](https://en.wikipedia.org/wiki/Universal_motor) can operate on direct current but is a lightweight [brushed](https://en.wikipedia.org/wiki/Brush_(electric)) motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of [power electronics](https://en.wikipedia.org/wiki/Power_electronics) has made replacement of DC motors with [AC motors](https://en.wikipedia.org/wiki/AC_motors) possible in many applications.



## 

## L298N DUAL H BRIDGE MOTOR DRIVER

**L298N Dual H Bridge Motor Driver** is a motor controller breakout board which is typically used for controlling speed and direction of motors. It can also be used to control the brightness of certain lighting projects such as high powered LED arrays .An H-bridge is a circuit that can drive a current in either polarity and be controlled by pulse width modulation.

## 

## The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.

## The L298N is an integrated monolithic circuit in a 15- lead Multiwatt and PowerSO20 packages. It is a high voltage , high current dual full-bridge driver de-signed to accept standard TTL logic level sand drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the in-put signals .The emitters of the lower transistors of each bridge are connected together rand the corresponding external terminal can be used for the connection of an external sensing resistor. An additional Supply input is provided so that the logic works at a lower voltage.

## Features

## High operating voltage, which can be up to 40 volts; Large output current, the instantaneous peak current can be up to 3A; Two built in H-bridge, high voltage, large current, full bridge driver, which can be used to drive DC motors, stepper motors, relay coils and other inductive loads. Able to drive a two-phase stepper motor or four-phase stepper motor, and two- Adopt a high-capacity filter capacitor and a freewheeling diode that protects devices in the circuit from being damaged by the reverse current of an inductive load.The module can utilize the built-in stabilivolt tube 78M05 to obtain 5v from the power supply. But to protect the chip of the 78M05 from damage, when the drive voltage is greater than 12v, an external 5v logic supply should be used.

## BLOCK DIAGRAM

## 

## 4.10 EMBEDDED SYSTEM

An **embedded system** is a [computer system](https://en.wikipedia.org/wiki/Computer_system)—a combination of a [computer processor](https://en.wikipedia.org/wiki/Computer_processor), [computer memory](https://en.wikipedia.org/wiki/Computer_memory), and [input/output](https://en.wikipedia.org/wiki/Input/output) peripheral devices—that has a dedicated function within a larger mechanical or [electronic](https://en.wikipedia.org/wiki/Electronics) system. It is *embedded* as part of a complete device often including electrical or electronic hardware and mechanical parts. Because an embedded system typically controls physical operations of the machine that it is embedded within, it often has [real-time computing](https://en.wikipedia.org/wiki/Real-time_computing) constraints. Embedded systems control many devices in common use today.[[3]](https://en.wikipedia.org/wiki/Embedded_system#cite_note-:0-3) In 2009, it was estimated that ninety-eight percent of all microprocessors manufactured were used in embedded systems.[[4]](https://en.wikipedia.org/wiki/Embedded_system#cite_note-4)[[*needs update*](https://en.wikipedia.org/wiki/Wikipedia:Manual_of_Style/Dates_and_numbers#Chronological_items)]

Modern embedded systems are often based on [microcontrollers](https://en.wikipedia.org/wiki/Microcontroller) (i.e. microprocessors with integrated memory and peripheral interfaces), but ordinary microprocessors (using external chips for memory and peripheral interface circuits) are also common, especially in more complex systems. In either case, the processor(s) used may be types ranging from general purpose to those specialized in a certain class of computations, or even custom designed for the application at hand. A common standard class of dedicated processors is the [digital signal processor](https://en.wikipedia.org/wiki/Digital_signal_processor) (DSP).

Since the embedded system is dedicated to specific tasks, [design engineers](https://en.wikipedia.org/wiki/Design_engineer) can optimize it to reduce the size and cost of the product and increase its reliability and performance. Some embedded systems are mass-produced, benefiting from [economies of scale](https://en.wikipedia.org/wiki/Economies_of_scale).

Embedded systems range in size from portable personal devices such as [digital watches](https://en.wikipedia.org/wiki/Digital_watch) and [MP3 players](https://en.wikipedia.org/wiki/MP3_player) to bigger machines like [home appliances](https://en.wikipedia.org/wiki/Home_appliances), industrial [assembly lines](https://en.wikipedia.org/wiki/Assembly_lines), robots, transport vehicles, [traffic light controllers](https://en.wikipedia.org/wiki/Traffic_light_control_and_coordination), and [medical imaging](https://en.wikipedia.org/wiki/Medical_imaging) systems. Often they constitute subsystems of other machines like [avionics](https://en.wikipedia.org/wiki/Avionics) in [aircraft](https://en.wikipedia.org/wiki/Aircraft) and [spacecraft](https://en.wikipedia.org/wiki/Spacecraft). Large installations like [factories](https://en.wikipedia.org/wiki/Factories), [pipelines](https://en.wikipedia.org/wiki/Pipeline_transport) and [electrical grids](https://en.wikipedia.org/wiki/Electrical_grid) rely on multiple embedded systems networked together. Generalized through software customization, embedded systems such as [programmable logic controllers](https://en.wikipedia.org/wiki/Programmable_logic_controller) frequently comprise their functional units.

Embedded systems range from those low in complexity, with a single microcontroller chip, to very high with multiple units, [peripherals](https://en.wikipedia.org/wiki/Peripheral) and networks, which may reside in [equipment racks](https://en.wikipedia.org/wiki/Equipment_rack) or across large geographical areas connected via long-distance communications lines.

**4.10.1 Applications**

Embedded systems are commonly found in consumer, industrial, [automotive](https://en.wikipedia.org/wiki/Automotive_industry), [home appliances](https://en.wikipedia.org/wiki/Home_appliance), medical, telecommunication, commercial, aerospace and military applications.

[Telecommunications](https://en.wikipedia.org/wiki/Telecommunication) systems employ numerous embedded systems from [telephone switches](https://en.wikipedia.org/wiki/Telephone_switch) for the network to [cell phones](https://en.wikipedia.org/wiki/Mobile_phone) at the [end user](https://en.wikipedia.org/wiki/End_user). Computer networking uses dedicated [routers](https://en.wikipedia.org/wiki/Router_(computing)) and [network bridges](https://en.wikipedia.org/wiki/Network_bridge) to route data.

[Consumer electronics](https://en.wikipedia.org/wiki/Consumer_electronics) include [MP3 players](https://en.wikipedia.org/wiki/MP3_player), [television sets](https://en.wikipedia.org/wiki/Television_set), [mobile phones](https://en.wikipedia.org/wiki/Mobile_phone), [video game consoles](https://en.wikipedia.org/wiki/Video_game_console), [digital cameras](https://en.wikipedia.org/wiki/Digital_camera), [GPS](https://en.wikipedia.org/wiki/Global_Positioning_System) receivers, and [printers](https://en.wikipedia.org/wiki/Computer_printer). Household appliances, such as [microwave ovens](https://en.wikipedia.org/wiki/Microwave_oven), [washing machines](https://en.wikipedia.org/wiki/Washing_machine) and [dishwashers](https://en.wikipedia.org/wiki/Dishwashers), include embedded systems to provide flexibility, efficiency and features. Advanced [heating, ventilation, and air conditioning](https://en.wikipedia.org/wiki/Heating,_ventilation,_and_air_conditioning) (HVAC) systems use networked [thermostats](https://en.wikipedia.org/wiki/Thermostat) to more accurately and efficiently control temperature that can change by time of day and [season](https://en.wikipedia.org/wiki/Season). [Home automation](https://en.wikipedia.org/wiki/Home_automation) uses wired- and wireless-networking that can be used to control lights, climate, security, audio/visual, surveillance, etc., all of which use embedded devices for sensing and controlling.

Transportation systems from flight to automobiles increasingly use embedded systems. New airplanes contain advanced [avionics](https://en.wikipedia.org/wiki/Avionics) such as [inertial guidance systems](https://en.wikipedia.org/wiki/Inertial_guidance_system) and [GPS](https://en.wikipedia.org/wiki/Global_Positioning_System) receivers that also have considerable safety requirements. Spacecraft rely on avionics systems for trajectory correction. Various electric motors — [brushless DC motors](https://en.wikipedia.org/wiki/Brushless_DC_motor), [induction motors](https://en.wikipedia.org/wiki/Induction_motor) and [DC motors](https://en.wikipedia.org/wiki/DC_motor) — use electronic [motor controllers](https://en.wikipedia.org/wiki/Motor_controller). [Automobiles](https://en.wikipedia.org/wiki/Automobile), [electric vehicles](https://en.wikipedia.org/wiki/Electric_vehicle), and [hybrid vehicles](https://en.wikipedia.org/wiki/Hybrid_vehicle) increasingly use embedded systems to maximize efficiency and reduce pollution. Other automotive safety systems using embedded systems include [anti-lock braking system](https://en.wikipedia.org/wiki/Anti-lock_braking_system) (ABS), [electronic stability control](https://en.wikipedia.org/wiki/Electronic_stability_control) (ESC/ESP), [traction control](https://en.wikipedia.org/wiki/Traction_control_system) (TCS) and automatic [four-wheel drive](https://en.wikipedia.org/wiki/Four-wheel_drive).

[Medical equipment](https://en.wikipedia.org/wiki/Medical_equipment) uses embedded systems for [monitoring](https://en.wikipedia.org/wiki/Monitoring_(medicine)), and various [medical imaging](https://en.wikipedia.org/wiki/Medical_imaging) ([positron emission tomography](https://en.wikipedia.org/wiki/Positron_emission_tomography) (PET), [single-photon emission computed tomography](https://en.wikipedia.org/wiki/Single-photon_emission_computed_tomography) (SPECT), [computed tomography](https://en.wikipedia.org/wiki/Computed_tomography) (CT), and [magnetic resonance imaging](https://en.wikipedia.org/wiki/Magnetic_resonance_imaging) (MRI) for non-invasive internal inspections. Embedded systems within medical equipment are often powered by industrial computers.[[8]](https://en.wikipedia.org/wiki/Embedded_system#cite_note-8)

Embedded systems are used for [safety-critical systems](https://en.wikipedia.org/wiki/Safety-critical_system) in aerospace and defense industries. Unless connected to wired or wireless networks via on-chip 3G cellular or other methods for IoT monitoring and control purposes, these systems can be isolated from hacking and thus be more secure. For fire safety, the systems can be designed to have a greater ability to handle higher temperatures and continue to operate. In dealing with security, the embedded systems can be self-sufficient and be able to deal with cut electrical and communication systems.

Miniature wireless devices called [motes](https://en.wikipedia.org/wiki/Mote_(sensor)) are networked wireless sensors. [Wireless sensor networking](https://en.wikipedia.org/wiki/Wireless_sensor_networking) makes use of miniaturization made possible by advanced [integrated circuit](https://en.wikipedia.org/wiki/Integrated_circuit) (IC) design to couple full wireless subsystems to sophisticated sensors, enabling people and companies to measure a myriad of things in the physical world and act on this information through monitoring and control systems. These motes are completely self-contained and will typically run off a battery source for years before the batteries need to be changed or charged.

**4.10.2 Characteristics**

Embedded systems are designed to do some specific task, rather than be a general-purpose computer for multiple tasks. Some also have [real-time](https://en.wikipedia.org/wiki/Real-time_computing) performance constraints that must be met, for reasons such as safety and usability; others may have low or no performance requirements, allowing the system hardware to be simplified to reduce costs.

Embedded systems are not always standalone devices. Many embedded systems consist of small parts within a larger device that serves a more general purpose. For example, the [Gibson Robot Guitar](https://en.wikipedia.org/wiki/Gibson_Robot_Guitar) features an embedded system for tuning the strings, but the overall purpose of the Robot Guitar is, of course, to play music.[[9]](https://en.wikipedia.org/wiki/Embedded_system#cite_note-9) Similarly, an embedded system in an [automobile](https://en.wikipedia.org/wiki/Automobile) provides a specific function as a subsystem of the car itself.

[](https://en.wikipedia.org/wiki/File:ESOM270_eSOM300_Computer_on_Modules.jpg)

e-con Systems eSOM270 & eSOM300 Computer on Modules

The program instructions written for embedded systems are referred to as [firmware](https://en.wikipedia.org/wiki/Firmware), and are stored in read-only memory or [flash memory](https://en.wikipedia.org/wiki/Flash_memory) chips. They run with limited computer hardware resources: little memory, small or non-existent keyboard or screen.

## SOFTWARE DESCRIPTION

* 1. **Keil µ Vision5 software for embedded C programming**

The µVision IDE combines project management, run-time environment, build facilities, source code editing, and program debugging in a single powerful environment. µVision is easy-to-use and accelerates your embedded software development. µVision supports multiple screens and allows you to create individual window layouts anywhere on the visual surface.

The [µVision Debugger](https://www.keil.com/mdk5/debug) provides a single environment in which you may test, verify, and optimize your application code. The debugger includes traditional features like simple and complex breakpoints, watch windows, and execution control and provides full visibility to device peripherals.

**CHAPTER 5**

## 5.1 CODING

#include<P89V51RD2.H>

#include<pro\_alcd.c>

#include<pro\_uart.c>

#include<PGSM.c>

sbit w\_m1=P1^2;

sbit w\_m2=P1^3;

sbit w\_m11=P1^4;

sbit w\_m22=P1^5;

sbit relayb=P3^3;

//sbit relayf=P3^4;

//sbit ir=P1^0;

int i;

int x=0;

void Device\_Init( void );

void MSDelay(unsigned int );

void main()

{

Device\_Init( );

UART\_ST( "AT+CMGF=1\r\n");

MSDelay(500);

UART\_ST( "AT+CNMI=2,2,0,0,0\r\n");

relayb=0;

//relayf=0;

while(1)

{

if( Rx\_ST\_Flag == 1 )

{

MSDelay(500); // 0.5 sec delay

Rx\_ST\_Flag = 0;

MSDelay(500);

Rx\_count =0; // Take UART Receiver array to zeroth location

i=0;

while(Rx\_data\_arr[i] !='\0')

{

if(Rx\_data\_arr[i] =='1')

{

w\_m1=1;//+terminal of right

w\_m2=0;//-of terminal right

w\_m11=1;//+ terminal of left

w\_m22=0;//- terminal of left

Rx\_count =0;

}

if(Rx\_data\_arr[i] =='2')

{

w\_m1=0;

w\_m2=1;

w\_m11=0;

w\_m22=1;

Rx\_count =0;

}

if(Rx\_data\_arr[i] =='4')//left direction

{

w\_m1=1;

w\_m2=0;

w\_m11=0;

w\_m22=1;

MSDelay(1500);

w\_m1=0;

w\_m2=0;

w\_m11=0;

w\_m22=0;

Rx\_count =0;

}

if(Rx\_data\_arr[i] =='3')

{

w\_m1=0;

w\_m2=1;

w\_m11=1;

w\_m22=0;

MSDelay(1500);

w\_m1=0;//right

w\_m2=0;

w\_m11=0;

w\_m22=0;

Rx\_count =0;

}

if(Rx\_data\_arr[i] =='5')

{

w\_m1=0;

w\_m2=0;

w\_m11=0;

w\_m22=0;

Rx\_count =0;

}

if(Rx\_data\_arr[i] =='6')

{

relayb=1;

Rx\_count =0;

}

if(Rx\_data\_arr[i] =='7')

{

relayb=0;

Rx\_count =0;

}

i++;

}

}

}

}

void Device\_Init( void)

{

//ALCD\_Message( 0x80, "WELCOME" );

//MSDelay(500);

}

**5.2 SOFTWARE Description**

The online execution phase consists of two functions: one on computer access and the other on wheelchair navigation, which are arguably the most important daily tasks for most TDS users [23]. This real-time SSP algorithm, which includes SVM-based pattern recognition, is implemented in BBB using C++. Support vector machine with a linear kernel is used to classify seven tongue commands because of the high accuracy, low computation requirements, and low false positive rate compared to the KNN algorithm used in the previous system [37]. The system requires a 20 s calibration and 70 s training (10 s for each command) by placing magnetic tracer to the shown landmarks (different teeth and cheek) in Fig. 3 before execution. Data contains outputs from the five sensors (four of them around the cheek) including a reference magnetometer (control unit). A least square error (LSE) method is used to find four projection matrices from the calibration data to attenuate the earth magnetic field (EMF) interferences. 12 dimensional EMF denoised features are used as inputs to the one vs. one classification algorithm during the training and execution. 21 support vector machines (7 tongue commands) Fig. 3. Simplified flowchart showing TDS communication with PC and wheelchair, as well as the vector-based linear and rotation speed control of the wheelchair. Real-time command processing step are shown in the right. are trained to find the weights, W and bias, B matrices. During the execution, maximum vote wins technique is used to find the winning class among 7 commands as an output. All these computations were done in the BBB at a sampling rate of 100 commands/s. If PC is selected, then tongue commands are translated to keyboard arrow keys to navigate the cursor to play the game. For PWC control, tongue commands are translated to analog driving vectors as DAC outputs. This process continues in an infinite loop until there is a stop request by the user through the UI. The current system does not use a microphone to detect the speech of the user. However, the algorithm utilizes tongue movements to differentiate between a command and speech. Participants usually move the tongue in the sagittal plane of the mouth while speaking unlike assigning a command. The sagittal plane tongue position is trained as a resting command of the classification algorithm. Landmarks other than the resting (LEFT, RIGHT, UP, DOWN, LS, RS) are chosen in a way so that the tongue must move away from the sagittal plane to assign a command. By incorporating these techniques, the current algorithm can differentiate between a tongue command and speech.

**5.3 PROTOCOL**

1. Protocol Fifteen able-bodied volunteers (C01-C15), 8 males and 7 females between the ages of 18 to 35 years old, one of whom was experienced, one was intermediate, and 13 naive with respect to TDS, participated in this study. The study involved one session per subject which was divided into three parts (preparation, training, and execution) and limited to three hours. During the preparation, participants were introduced with the PC access and wheelchair driving tasks followed by signing a consent form. The preparation continued by attaching a small disk-shaped magnetic tracer (∅4.8 mm ×1.5 mm, K&J Magnetics, Jamison, PA), to ∼1 cm from the tip of the tongue using a cyanoacrylate tissue adhesive, similar to [22]. Attaching the magnetic tracer to the tongue tip is a temporary solution to test the efficacy of the system. However, for longterm usage, a participant will need to do a tongue piercing, and a magnetic tracer will be used as a stud to find the tongue commands. During the training, the headset was calibrated (20 s process) to remove earth’s magnetic field (EMF), and seven tongue commands were trained (10 s each command, total 70 s). In the execution part, a PC task and three modes of wheelchair driving were done using tongue commands. PC tasks were compared with keyboard arrow keys and wheelchair driving with a joystick. Each task was repeated in four rounds, first as practice and rest three for evaluation. Table I shows the summary of the tasks and performance measures.

# SNAPSHOTS

# 

# CHAPTER 6 CONCLUSION

Tongue Drive system (TDS) is a tongue-operated unobtrusive wireless assistive technology, which can potentially provide people with severe disabilities. It has translated users intentions into control commands by detecting and classifying their voluntary tongue motion utilizing a small permanent magnet, secured on the tongue. Array of magnetic sensors mounted on a headset outside the mouth and orthodontic brace inside. We have developed customized interface circuitry and implemented four control strategies to drive a Powered Wheel Chair (PWC) using an external TDS prototype.

## FUTURE WORKS

For future work, it is suggested to use a more powerful and lighter weight motor to support various weights of users. This project elaborates the design and construction of Smart Electronic Wheelchair with the help of Bluetooth Module. The wheelchair works properly to move as the command given by the user. After this design the physically disabled to control their wheel using an android application in their smartphones and it also reduces human effort. The detection of any obstacle may be the future scope. As the person switches on it starts moving in all the four directions which also helps the disabled person to do their works independently.

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