BLUETOOTH CONTROLLED PICK AND PLACE ROBOT

A PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report **“BLUETOOTH CONTROLLED PICK AND PLACE ROBOT”** is the bonafide work of **“JAYA PREETHA.S (211419105053), “ANJALI.M(211419105008), and SANJEETHA.M (211419105124)”** who carried out the project work under my supervision.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

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LIST OF ABBREVIATION

S.NO	ABBREVIATION	ACRONYMS
1.	UART	Universal asynchronous receiver-transmitter
2.	GUI	Graphical user interface
3.	DC	Direct current
4.	IDE	Integrated development Environment
5.	UWB	Ultra wide-band
6.	MAC	Media access control
7.	PHY	Physical
8.	OPSOG	Omni purpose soft gripper
9.	IOT	Internet of things
10.	ADPLL	All digital phase locked loop
11.	BLE	Bluetooth low energy
12.	TX	Transmitter
13.	V	Volt
14.	IC	Integrated circuit

ABSTRACT

Cultivating and setting tomatoes our project is a Bluetooth-controlled robot whose robotic arm may be operated from a distance. Robot electronic devices can be wirelessly controlled with this connection. Bluetooth allows for hands-free operation without the need for a physical cable connection. This project's goal is to use a pick and place arm to correctly select apples and position a bucket. Our state-of-the-art project allows users to easily command a variety of robotic devices without physically moving them. Placement of Apples To harvest tomatoes from a tree, a robot equipped with Bluetooth control is employed. These are some of the contexts in which it is employed. In this study, we offer the design analysis of a ‘'Bluetooth-controlled pick and place" robotic vehicle. This research elucidates the necessity of safety procedures in the workplace and the surrounding environment for the successful completion of certain tasks, such as dispatching a robotic vehicle into a potentially dangerous area to collect samples for chemical analysis. Using a microcontroller, it is a control system that communicates with Android software. Accessible through android app, it allows for complete remote control of the vehicle and its robotic arms. A Bluetooth module serves as the system's receiver in the car. This triggers the microcontroller to act in response to Bluetooth signals. Shown here is the blueprint for a robot that can rotate in all directions and is fitted with a gripper for performing the pick-and-place operation with tomatoes. The operator's cell phone will serve as the interface for all of these functions. The microcontroller then sends the robot the appropriate mobility commands based on the button the user selects in the application. The goal of this project is to create a mobile robot that can move in response to user input via an app.

LIST OF FIGURES

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION

1.1 Robot in Industry:

A robot is a type of electromechanical machine that can be programmed to carry out a wide variety of tasks. Robots are becoming more and more commonplace in today's society. Industrial robots were originally developed to carry out tasks that were previously carried out by humans; this was done with the intention of increasing output while simultaneously reducing expenses. The computer mouse and keyboard are being phased out in favour of a method of human-machine interaction that is both more pervasive and more in tune with the real world. This change is occurring in the way humans interact with machines. Because the controller and the Android device are connected via Bluetooth to one another, an Android app can be used to control the motion of the robot remotely from a distance.

The Bluetooth module is able to communicate with the microcontroller through the use of the UART protocol as a result of code that was written in embedded C. Instructions that are sent from an app on an Android device can be used to control how the robot moves. The motion that is output by a robotic vehicle is both consistent and precise. Robots that perform pick-and-place operations use interchangeable tools that can be reprogrammed for a variety of new tasks. This project's objective is to build a Bluetooth robot that can be controlled by an Android device and put to use in a variety of contexts, including but not limited to surveillance, home automation, wheelchairs, the military, and hostage rescue.

Submissions for the Rescue Application.

The end result of this project is intended to be a pick-and-place robot that features a gentle gripper. This project's objective is to design and build a pick-andplace robotic vehicle that is also fitted with a gripper for the purpose of picking up tomatoes. The graphical user interface (GUI) of any Android-powered mobile device, such as a smartphone or tablet, that has a touch screen can be used as a remote control (Graphical User Interface). To phrase it another way, this prototype will serve as the foundation upon which production models based on the same core concept will be built.

An Android application on the receiving end will send a signal to a Bluetooth module (HC-05) that is acting as an interface between a mobile device and a car. The signal will be in the form of an ASCII code (robot). The microcontroller is capable of controlling the motors that propel the robot as well as those that allow it to grasp objects. The controls for each of these motors were programmed into the device. Sending commands from an android application device at the transmitting end to a receiver allows for the robot to be moved in any of four directions: forward, backward, left, or right.

The robot's arms and grippers are moved by the use of three of the motors, while the body of the robot is moved by the use of the other two motors. The android app device that serves as the transmitter functions as a remote control that has a sufficient range, and the data from the Bluetooth device that is located at the receiving end is sent into the microcontroller. The microcontroller then drives DC motors via motor driver IC in order to complete the task that is at hand. The graphical user interface (GUI) of any Android-powered mobile device, such as a smartphone or tablet, that has a touch screen can be used as a remote control (Graphical User Interface). The most appealing feature of this robot is its gentle grabbing arm, which is designed to avoid applying any additional pressure to the object that is under investigation.

1.2 Pick and place Operation:

The pick-and-place operation as well as the movement of the Robot [5] can be controlled wirelessly through an Android smartphone by utilising the Bluetooth functionality that is included in it. Within the context of this project, an Android smart phone is put to use in the capacity of a remote control for the Robot. The ATmega328 Microcontroller that is integrated into the Arduino UNO Board serves as the central processing unit for the entire control apparatus. The microcontroller functions as an interface between the motors, Bluetooth, and an Android mobile device, each of which already has a Bluetooth module built in. The data is provided as input to the controller by the Bluetooth module after it has been received from an Android smart phone. The DC motors of the robot are affected by the controller in the appropriate manner. In order to complete the task, the controller is loaded with a programme that was created with the Arduino IDE software.

1.3 Need for apple pick and place material handling:

- Reduction of lab our and material cost
- Reduction of overall cost
- Increased safety
- Reduction in fatigue
- Improved personnel comfort

CHAPTER 2

LITERATURE SURVEY

[1] N S Krishna raj Rao, N J Avinash, et al "An Automated Robotic Arm: A Machine Learning Approach,2021"-IEEE International Conference on Mobile Networks and Wireless Communications (ICMNWC)

The term 'robot' generally refers to a machine that looks and works in a way similar to a human. The modern industry is rapidly shifting from manual control of systems to automation, in order to increase productivity and to deliver quality products. Computer-based systems, though feasible for improving quality and productivity, are inflexible to work with, and the cost of such systems is significantly high. This led to the swift adoption of automated systems to perform industrial tasks. One such task of industrial significance is of picking and placing objects from one place to another. The implementation of automation in pick and place tasks helps to improve efficiency of system and also the performance. In this paper, we propose to demonstrate the designing and working of an automated robotic arm with the Machine Learning approach. The work uses Machine Learning approach for object identification / detection and traversal, which is adopted with TensorFlow package for better and accurate results.

[2] Vikas Varshney, Arvind Kumar, et al "Design and Development of Intellectual Robotic Arm, 2019"-6th International Conference on Computing for Sustainable Global Development (INDIACom)

Humanity has always endeavoured to provide life like traits to its merchandise in an effort to discover replacement for himself to carry out his commands and also to work in an unfriendly environment. The admired concept of an intellectual robot is to construct a machine whose works resembling a human being. The industries are taking necessary steps to move from automation to robotization in order to raise efficiency and deliver consistent quality. By considering these features, an Intellectual Robotic Arm has been designed and developed which can be controlled and operated through a Smartphone via Bluetooth. The model presented in this paper uses Bluetooth module to create an interface between the hardware and software. The software Arduino IDE is used for coding and Arduino UNO is used for the execution of the program which controls the movements as well as functions of the robotic arm in desired manner. The designing as well as the successful execution of this model has been obtained by testing the picking and dropping of light weighted objects. Bluetooth and wireless technology make this model more reliable. Also, acrylic sheet is used for creating the frame of the model in order to minimize the weight and hence the load on the wheels of the robot.

[3] Progress Mtshali, Freedom Khubisa, et al "A Smart Home Appliance Control System for Physically Disabled People, 2019"-Conference on Information Communications Technology and Society (ICTAS)

The construction and conversion of ordinary homes into "smart homes" has seen a tremendous rise in recent years. This can be ascribed to technologies such as the Internet of Things, sensors, smart phones, smart appliances, cloud computing, and digital assistants such as Amazon Alexa, Google Home, Google Assistant, Apple Siri, and Microsoft Cortana. At the outset, smart homes were built to enhance the quality of life for ordinary nondisabled persons. Impressively, we have seen smart home residents reaping the benefits of security, energy saving, and the ability to control their lighting, HVAC (heating, ventilation, and air conditioning), door locks, and coffee makers while they are in their space of comfort, for example in bed or siting on a couch. However, most smart home devices are not designed with people with disabilities and limited range of movement in mind. Of course, being able to control home devices using smart technology could be a tremendous benefit to people with physical disabilities and the older persons. This paper presents a system that uses smart plugs, smart cameras, smart power strips and a digital assistant such as Amazon Alexa, Google Home, Google Assistant, Apple Siri, or Microsoft Cortana to capture voice commands, from a person with physical disabilities, spoken in a much more natural way to control ordinary home electrical appliances in order to turn them on or off, with minimal exertion.

[4] Aaron Bradyonic Andrew, Suraj A Rajiv, et al "Implementation of Low-cost Voice Command Robot Using Arduino Uno Platform,2021"-IEEE 7th International Conference on Smart Instrumentation, Measurement and Applications (ICSIMA)

Technology has advanced beyond our wildest dreams in recent years. It helps human in daily lives, and there's still a lot more to learn about it in the future. Some problems, such as handicapped individuals and senior folks who are unable to enjoy the freedom of driving alone, have still to be addressed. The Voice Control Robot may be useful in solving this issue. The interaction required for this robot to function autonomously is a voice command via a smartphone app. The goal of this project is to allow users to control the robotic ivehicle using voice commands from a distance. From the result, the robotic car can do the following tasks is built. It can move forward, backward, turn left and right and can stop when it senses an obstacle. The voice command commands are efficiently communicated through Bluetooth innovation, and the required actions are successfully carried out. When the size of this prototype project of a voice control robot is substantially expanded, disabled persons and elderly citizens will be able to enjoy the independence of traveling in a vehicle by themselves. It also reduces human efforts in places or situations when human intervention is problematic. As a result, it may be put to use in today's global industry. Future plans for the voice control robot may be improved in a venture that can also be used for home security and military reasons, with instructions delivered to the robot using a wider range of signal and other characteristics electronic.

[5] Yuan Zhuang, Changying Zhang, et al "Bluetooth Localization Technology: Principles, Applications, and Future Trends, 2022"- IEEE Internet of Things Journal

The rapid development of the Bluetooth technology offers a possible solution for indoor localization scenarios. Compared with other indoor localization technologies, such as vision, light detection and ranging, ultrawide band, etc., Bluetooth has been characterized by low cost, easy deployment, low energy consumption, and potentially high localization accuracy, which enable itself to be a competitive technology in indoor location-based services, the Internet of Things, and many other fields. In this article, we first present a comprehensive survey of Bluetooth localization technology, including the measurements for localization, working principles, and method comparison. We highlight the learning-based methods and integrated localization methods. Then, we review the applications and existing commercial solutions, revealing the possible directions for the industrialization of Bluetooth localization. Finally, this article proposes several open issues of Bluetooth localization (e.g., multichannel difference, multipath, cochannel interference, and device heterogeneity) and projects several future trends.

[6] Dieter Coppens, Adnan Shahid, et al "An Overview of UWB Standards and Organizations (IEEE 802.15.4, Firas, Apple): Interoperability Aspects and Future Research Directions,2022"- IEEE Access

The increasing popularity of ultra-wideband (UWB) technology for location based services, such as access control and real-time indoor track tracing, as well as UWB support in new consumer devices such as smartphones, has resulted in the availability of multiple new UWB radio chips. However, due to this increase in UWB device availability, the question of which (industry) standards and configuration factors impact UWB interoperability and compatibility becomes increasingly important. In this paper, the fundamentals of UWB compatibility are investigated by first giving an overview of different UWB radio chips on the market. After that, an overview of UWB standards and organizations is given. Next, this overview is used to discuss the focus of these different standards and to identify the differences between them. We describe compatibility issues and associated interoperability aspects related to physical (PHY), medium-access control (MAC) and upper layers. For the PHY layer, compatibility is possible for all UWB radio chips if the correct settings are configured. For the MAC layer, the implementation of the multiple access scheme as well as the localization technique is mostly proprietary. For the device discovery, several standards are currently being drafted. Finally, future challenges related to UWB interoperability are discussed.

[7] Charbel Taw, Andrew Gillett, et al "A 3D-Printed Omni-Purpose Soft Gripper, 2019"- IEEE Transactions on Robotics

Numerous soft grippers have been developed based on smart materials, pneumatic soft actuators, and underactuated compliant structures. In this article, we present a three-dimensional (3-D) printed omni-purpose soft gripper (OPSOG) that can grasp a wide variety of objects with different weights, sizes, shapes, textures, and stiffnesses. The soft gripper has a unique design that incorporates soft fingers and a suction cup that operate either separately or simultaneously to grasp specific objects. A bundle of 3-D-printable linear soft vacuum actuators (LSOVA) that generate a linear stroke upon activation is employed to drive the tendon-driven soft fingers. The support, fingers, suction cup, and actuation unit of the gripper were printed using a low-cost and open-source fused deposition modelling 3-D printer. A single LSOVA has a blocked force of 30.35 N, a rise time of 94 Ms, a bandwidth of 2.81 Hz, and a lifetime of 26 120 cycles. The blocked force and stroke of the actuators are accurately predicted using finite element and analytical models. The OPSOG can grasp at least 20 different objects. The gripper has a maximum payload-to-weight ratio of 7.06, a grip force of 31.31 N, and a tip blocked force of 3.72 N.

[8] Siyun Liu, Qingjie Qi, et al "Development of indoor positioning system based on Bluetooth, 2021"- WRC Symposium on Advanced Robotics and Automation (WRC SARA)

In today's highly urbanized environment, indoor space is becoming more and more complex. In this paper, a fast real-time positioning system with high precision and low cost is developed based on Bluetooth signal. In this paper, the clients and servers are established with several Raspberry Pis, which can sense mobile detection targets by detecting Bluetooth signal. Information exchange is realized through web-based and embedded database applications. The smoothing algorithm is adopted to reduce positioning error, and graphical display technique is adopted for visualizing location information. The desired result is an integrated solution for Bluetooth-based indoor positioning system, which has a good application performance and practicability.

[9] Ravesa Akhter, Shabir Ahmad Sofi, et al "Precision agriculture using IoT data analytics and machine learning,2022"- Journal of King Saud University - Computer and Information Sciences

In spite of the insight commonality may have concerning agrarian practice, fact is that nowadays agricultural science diligence is accurate, precise, data-driven, and vigorous than ever. The emanation of the technologies based on Internet of Things (IoT) has reformed nearly each industry like smart city, smart health, smart grid, smart home, including "smart agriculture or precision agriculture". Applying machine learning using the IoT data analytics in agricultural sector will rise new benefits to increase the quantity and quality of production from the crop fields to meet the increasing food demand. Such world-shattering advancements are rocking the current agrarian approaches and generating novel and best chances besides a number of limitations. This paper climaxes the power and capability of computing techniques including internet of things, wireless sensor networks, data analytics and machine learning in agriculture. The paper proposed the prediction model of Apple disease in the apple orchards of Kashmir valley using data analytics and Machine learning in IoT system. Furthermore, a local survey was conducted to know from the farmers about the trending technologies and their effect in precision agriculture. Finally, the paper discusses the challenges faced when incorporating these technologies in the traditional farming approaches.

[10] Kyumin Kwon, Omar A. B. Abdelatty, et al "PLL Fractional Spur's Impact on FSK Spectrum and a Synthesizable ADPLL for a Bluetooth Transmitter,2023"- IEEE Journal of Solid-State Circuits

In this work, we present an open-source fully-synthesizable fractional-N all digital phase-locked loop (ADPLL) designed for a Bluetooth low-energy (BLE) transmitter (TX) along with a semi-analytical model of the PLL fractional spur's impact on the BLE output spectrum. Based on the model and the BLE specification for spur emission, a requirement for the PLL fractional spurs is derived. To meet the derived spectral mask by reducing the fractional spurs, a novel synthesizable two-step time to digital converter (TSTDC) that employs embedded TDC (EMBTDC) as coarse and Vernier delay-line TDC (DLTDC) as fine TDC is proposed. We also present a digital calibration scheme to compensate for the nonlinearity induced by the place-and-route (P&R) tool. The PLL is fabricated in 12-nm FinFET and demonstrated in a BLE-TX. The measured BLE transmissions satisfy the standard requirements thanks to the reduced fractional spurs. In a standalone PLL mode, the proposed TSTDC and calibration scheme reduced the fractional spurs by 14.3 dB compared to only using an EMBTDC in near-integer N operation. The PLL supports a frequency range of 1.8–2.7 GHz and consumes 3.91 mW at 2.4006 GHz achieving figure of merit (FoM) of − 220.7 dB in fractional-N mode with a 40 MHz reference, occupying an area of 0.063 mm 2 . A highly automated design flow is used for the PLL to lower the barrier for new developers and reduce the porting cost.

CHAPTER 3

PROPOSED SYSTEM

3.1 Sections:

The project contains 2 sections

1.Robot (Receiver end)

2.Control section (Transmitting end)

A Bluetooth-enabled Android phone will serve as the controller. Bluetooth on a mobile device will carry the commands needed to operate the robot.

The receiving end will also feature a Bluetooth module. In order for the Bluetooth devices to communicate with one another, they must be paired. All information supplied from the Bluetooth module at the sending end will immediately be received by the Bluetooth module at the receiving end. The microcontrollers check the incoming information against the stored information and act accordingly.

It has a microcontroller IC, a Bluetooth module, a power supply, and four DC motors with driver ICs. A robotic arm is mounted on a mobile platform and used for pick-and-place operations. The vehicle can travel over any surface, no matter how smooth or rugged it is. For reliable and smooth operation, a belt-type tyre is linked to the vehicle and powered by two motors, just like on tanks. Two motors propel the pick-and-place robot, and a second pair of motors perform the actual picking and placing. The jaw of the pick and place arm can only move vertically, so it can only pick up and position objects. The jaw's opening and closing action is powered by a separate motor from the arm assembly's up and down motion. Mechanical push-button switches cap the amount of up and down movement. As the arm reaches its farthest extent, the circuit is broken so that the motor cannot continue to revolve.

3.2 Advantages:

- The Motorized arm is more efficient in the technical field.
- Quick response is achieved.
- Simple in construction
- Easy to maintain and repair.
- Cost of the unit is less when compared to another robotics.
- Continuous operation is possible without stopping.

3.3 Limitations:

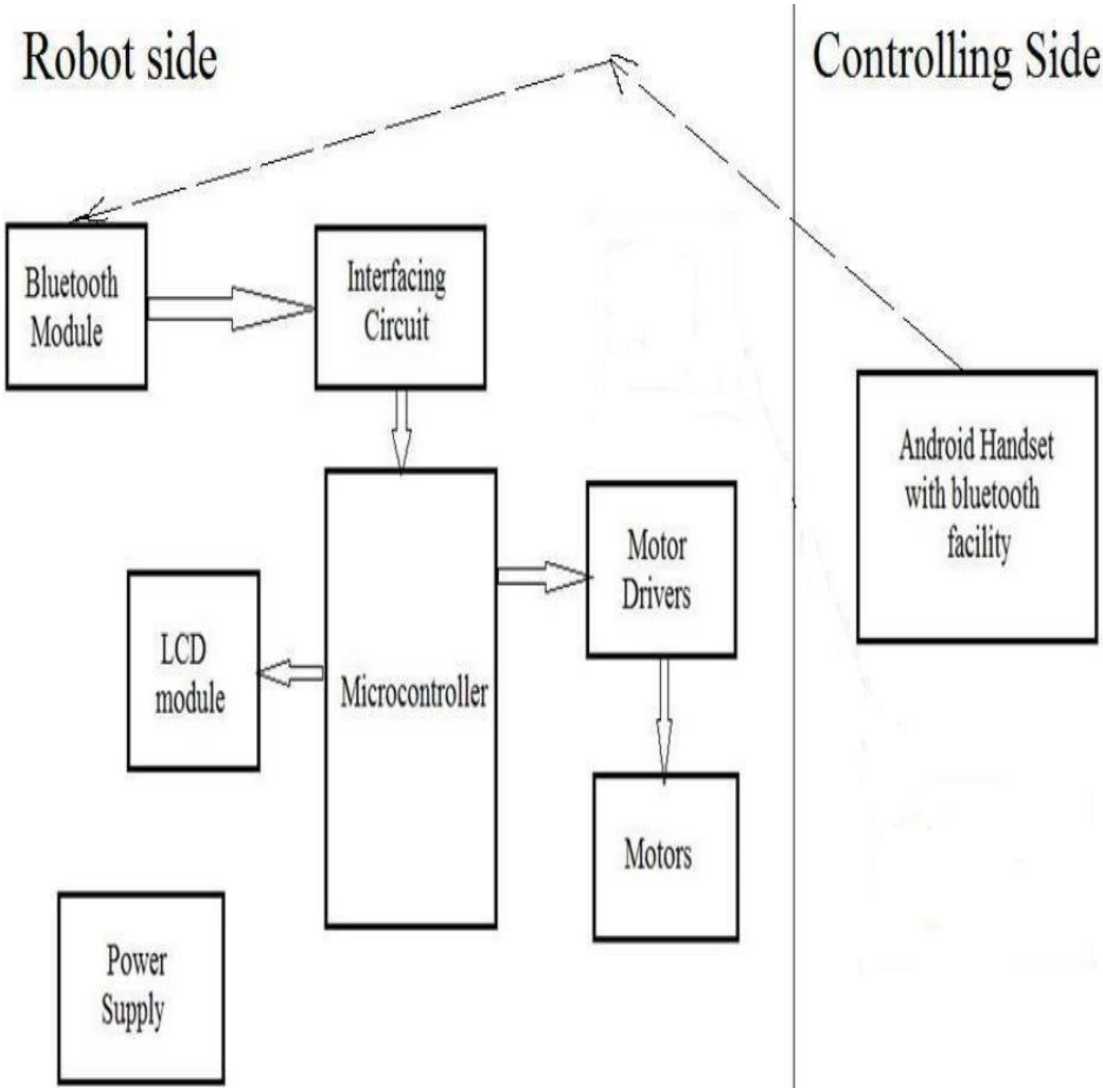
- Battery should be charged periodically.
- High torque cannot be obtained.

3.4 Application:

- Pick and place application
- Industrial Application
- Agricultural Applications
- Tool changing applications.

CHAPTER 4

BLOCK DIAGRAM AND DESCRIPTION



CHAPTER 5
WORKING PRINCIPLE

5.1 Design:

Motor driver IC and micro controller are utilized for motor control. An android device serves as a controller, providing input signals via a Bluetooth module interface with the microcontroller. Input 1, input 2, output 1, and output 2 are found in one set of L293D's configurations, while input 3, input 4, output 3, and output 4 are found in the other set. The code is structured in such a way that, when run, it communicates with the motor driver IC to run the motor and propel the robot forward, as was previously discussed. The Android device's built-in Bluetooth technology is utilised to transmit left/right/forward/backward/stop commands from the display.

The design uses a 12V battery in series with a diode D2 to deliver nearly 5V to the microcontroller through regulator IC LM 7805. The microcontroller also makes use of common connections such as a crystal and a reset arrangement indicator LED.

5.2 Microcontroller working:

A microcontroller is connected to a Bluetooth module driven by a reversebiased Zener diode D1, which, once linked with a smartphone, exchanges data with it in order to respond appropriately to a user's touches. To move the arm up and down and open and close, the project employs a second motor driver IC based on the same technology, which is interfaced to the microcontroller using pulledup resistors. The app is coded in such a way that touching the screen on a smartphone causes a command to be sent via the Bluetooth module; touching A means "open," B means "close," C means "up," and D means "down," with MC determining the correct rotation for the motor.

5.3 Arm Mechanism:

Consideration of the soft catching arm's mechanism is now in order. It uses an electrical current to detect pressure in the arm. At the output of the second motor driver IC L293D, power is distributed to the motors utilised for the up/down and open/closed gripper operations through a series resistor of 10 ohms/ 2 watt. This resistance is used to ground the current that flows back from the Driver IC when the motor is running. Current flowing through it is proportional to the load on the motor or the force exerted by the arm's clamping jaws, and voltage across it is proportional to this current.

Since the motor can rotate either clockwise or anticlockwise, the usual voltage drop across the 10R/2W ohm resistor indicates that the motor is operating under normal conditions. The micro controller constantly checks the voltage across the resistor as it rises in response to the growing load. When it gets too high, an interrupt is generated, which turns off the motor. After interrupt zero goes low, the programmer is designed so that the motor driver IC receives no input from the user for that motor's movement in any direction. The command can only make the device rotate in the opposite direction. As a result, the arm gripper can be set up with a softer catching configuration.

CHAPTER 6

HARDWARE REQUIREMENTS

6.1 Hardware description:

- Battery
- Microcontroller
- Relay board
- Dc motor
- Bluetooth module

6.1.1 Battery:

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photovoltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties:

(1) Low cost

(2) Long life

(3) High reliability

(4) High overall efficiency

(5) Low discharge

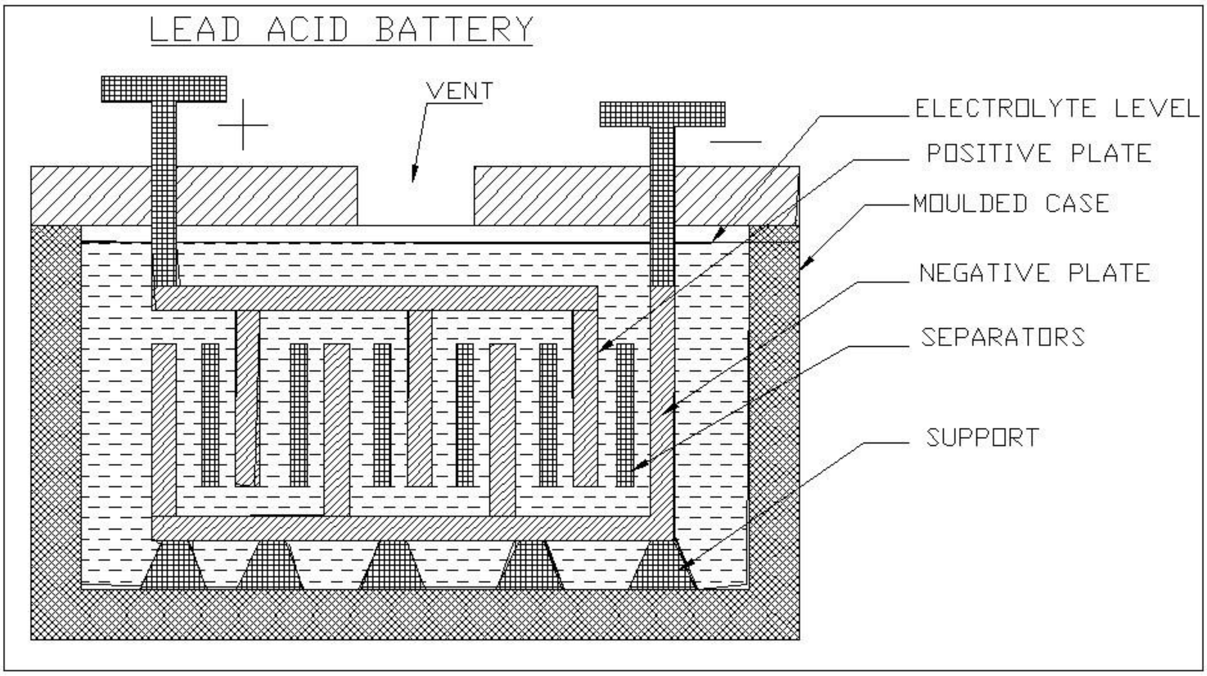
(6) Minimum maintenance

(A) Ampere hour efficiency

(B) Watt hour efficiency

We use lead acid battery for storing the electrical energy from the solar panel for lighting the street and so about the lead acid cells are explained below.

6.1.2 Lead acid wet cell:



Where high values of load current are necessary, the lead-acid cell is the type most commonly used. The electrolyte is a dilute solution of sulfuric acid (H_2SO_4). In the application of battery power to start the engine in an auto mobile, for example, the load current to the starter motor is typically 200 to

400A. One cell has a nominal output of 2.1V, but lead-acid cells are often used in a series combination of three for a 6-V battery and six for a 12-V battery.

The lead acid cell type is a secondary cell or storage cell, which can be recharged. The charge and discharge cycle can be repeated many times to restore the output voltage, as long as the cell is in good physical condition. However, heat with excessive charge and discharge currents short ends the useful life to about 3 to 5 years for an automobile battery. Of the different types of secondary cells, the lead-acid type has the highest output voltage, which allows fewer cells for a specified battery voltage.

6.1.2.1 Construction:

Inside a lead-acid battery, the positive and negative electrodes consist of a group of plates welded to a connecting strap. The plates are immersed in the electrolyte, consisting of 8 parts of water to 3 parts of concentrated sulfuric acid. Each plate is a grid or framework, made of a lead-antimony alloy. This construction enables the active material, which is lead oxide, to be pasted into the grid. In manufacture of the cell, a forming charge produces the positive and negative electrodes. In the forming process, the active material in the positive plate is changed to lead peroxide (pbo_2). The negative electrode is spongy lead (pb).

Automobile batteries are usually shipped dry from the manufacturer. The electrolyte is put in at the time of installation, and then the battery is charged to from the plates. With maintenance-free batteries, little or no water need be added in normal service. Some types are sealed, except for a pressure vent, without provision for adding water.

The construction parts of battery are shown in figure (6).

6.1.3 CHEMICAL ACTION:

Sulfuric acid is a combination of hydrogen and sulfate ions. When the cell discharges, lead peroxide from the positive electrode combines with hydrogen ions to form water and with sulfate ions to form lead sulfate. Combining lead on the negative plate with sulfate ions also produces he sulfate. Therefore, the net result of discharge is to produce more water, which dilutes the electrolyte, and to form lead sulfate on the plates.

As the discharge continues, the sulfate fills the pores of the grids, retarding circulation of acid in the active material. Lead sulfate is the powder often seen on the outside terminals of old batteries. When the combination of weak electrolyte and sulfating on the plate lowers the output of the battery, charging is necessary.

On charge, the external D.C. source reverses the current in the battery. The reversed direction of ions flows in the electrolyte result in a reversal of the chemical reactions. Now the lead sulfates on the positive plate reactive with the water and sulfate ions to produce lead peroxide and sulfuric acid. This action reforms the positive plates and makes the electrolyte stronger by adding sulfuric acid.

At the same time, charging enables the lead sulfate on the negative plate to react with hydrogen ions; this also forms sulfuric acid while reforming lead on the negative plate to react with hydrogen ions; this also forms currents can restore the cell to full output, with lead peroxide on the positive plates, spongy lead on the negative plate, and the required concentration of sulfuric acid in the electrolyte.

The chemical equation for the lead-acid cell is Charge.

$Pb + pbO_2 + 2H_2SO_4$ ——————————— $2pbSO_4 + 2H_2O$

$\longrightarrow$

Discharge

On discharge, the pb and pbo_2 combine with the SO_4 ions at the left side of the equation to form lead sulfate ($pbSO_4$) and water (H_2O) at the right side of the equation. One battery consists of 6 cells, each have an output voltage of 2.1V, which are connected in series to get an voltage of 12V and the same 12V battery is connected in series, to get an 24 V battery. They are placed in the water proof iron casing box.

6.1.4 PIC MICROCONTROLLER

The PIC microcontroller used here is 16F877A. This performs the key role of processing the received data from the sensors and transmitting them to the LiFi module. The advantage of microcontroller such as low power consumption and flexibility to connect other devices makes it as the best choice among other processors. The features of this microcontroller include the following.

- RISC architecture
- Operating frequency 0-20 MHz
- Power supply voltage 2.0-5.5V
- 8K ROM memory in FLASH technology
- 256 bytes EEPROM memory
- 368 bytes RAM memory
- A/D converter:
    - 14-channels
    - 10-bit resolution
- 3 independent timers/counters
- Watch-dog timer

PIC (usually pronounced as "pick") is a family of microcontrollers made by Microchip Technology, derived from the PIC1650 originally developed by General Instrument's Microelectronics Division. The name PIC initially referred to Peripheral Interface Controller and is currently expanded as Programmable Intelligent Computer. The first parts of the family were available in 1976; by 2013 the company had shipped more than twelve billion individual parts, used in a wide variety of embedded systems.

Early models of PIC had read-only memory (ROM) or field programmable EPROM for program storage, some with provision for erasing memory. All current models use flash memory for program storage, and newer models allow the PIC to reprogram itself. Program memory and data memory are separated. Data memory is 8-bit, 16-bit, and, in latest models, 32-bit wide. Program instructions vary in bit-count by family of PIC, and may be 12, 14, 16, or 24 bits long. The instruction set also varies by model, with more powerful chips adding instructions for digital signal processing functions.

The hardware capabilities of PIC devices range from 6-pin SMD, 8-pin DIP chips up to 144-pin SMD chips, with discrete I/O pins, ADC and DAC modules, and communications ports such as UART, I2C, CAN, and even USB. Low-power and high-speed variations exist for many types.

The manufacturer supplies computer software for development known as MPLAB X, assemblers and C/C++ compilers, and programmer/debugger hardware under the MPLAB and PICK it series. Third party and some open-source tools are also available. Some parts have in-circuit programming capability; low-cost development programmers are available as well as high-production programmers.

PIC devices are popular with both industrial developers and hobbyists due to their low cost, wide availability, large user base, extensive collection of application notes, and availability of low cost or free development tools, serial programming, and re-programmable flash-memory capability.

6.1.5 FEATURES

6.1.5.1 High-Performance RISC CPU

- Only 35 single-word instructions to learn.
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input DC – 200 ns instruction cycle

- Up to 8K x 14 words of Flash Program Memory, up to 368 x 8 bytes of Data Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory
- Pin out compatible to another 28-pin or 40/44-pin.
- PIC16CXXX and PIC16FXXX microcontrollers

6.1.5.2 Peripheral Features

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler, can be incremented during Sleep via external crystal/clock
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
    - Two Capture, Compare, PWM module
    - Capture is 16-bit, max. resolution is 12.5 ns o Compare is 16-bit, max. resolution is 200 ns
- PWM max. resolution is 10-bit
- Synchronous Serial Port (SSP) with SPI™ (Master mode) and I2C™ (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI) with 9-bit address detection
- Parallel Slave Port (PSP) – 8 bits wide with external RD, WR and CS controls (40/44-pin only)
- Brown-out detection circuitry for Brown-out Reset (BOR)

6.1.5.3 Analog Features

- 10-bit, up to 8-channel Analog-to-Digital Converter (A/D)
- Brown-out Reset (BOR)
- Analog Comparator module with:

  o Two analog comparators o Programmable on-chip voltage reference (VREF) module
  o Programmable input multiplexing from device inputs and internal voltage reference o Comparator outputs are externally accessible

6.1.5.4 Special Microcontroller Features

- 100,000 erase/write cycle Enhanced Flash program memory typical
- 1,000,000 erase/write cycle Data EEPROM memory typical
- Data EEPROM Retention > 40 years
- Self-reprogrammable under software control
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Single-supply 5V In-Circuit Serial Programming
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Programmable code protection
- Power saving Sleep mode

- Selectable oscillator options
- In-Circuit Debug (ICD) via two pins

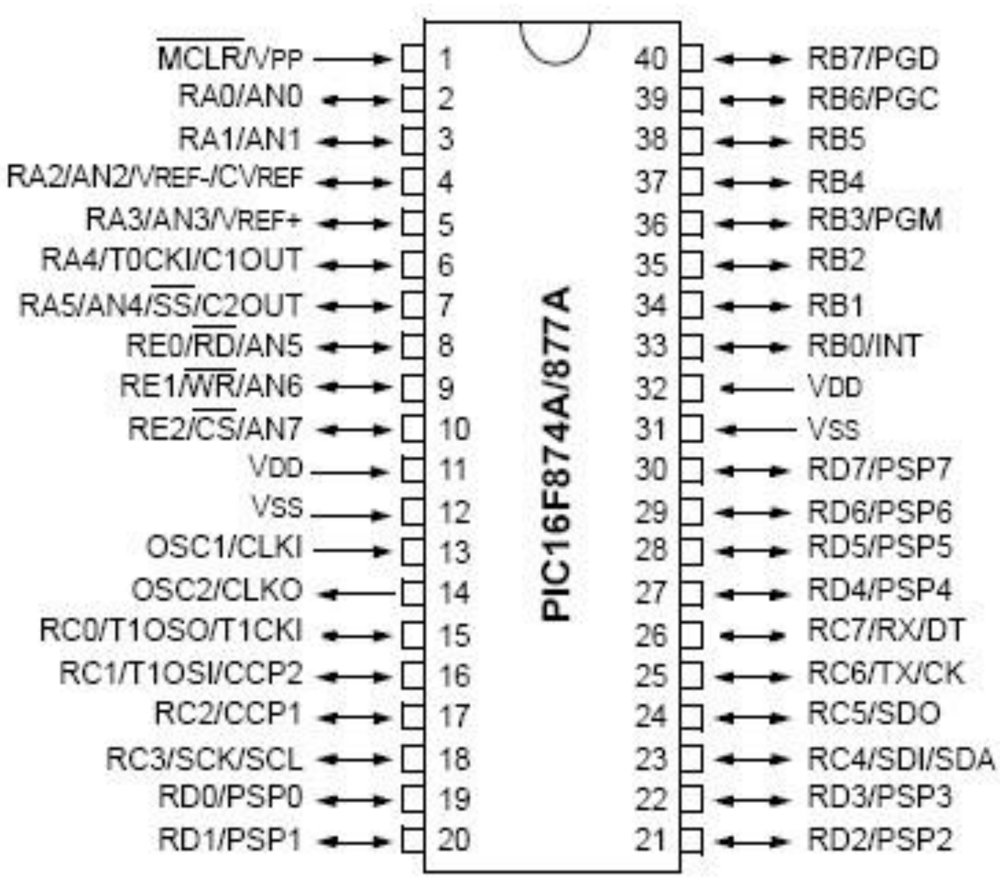
6.1.5.5 CMOS Technology

- Low-power, high-speed Flash/EEPROM technology
- Fully static design
- Wide operating voltage range (2.0V to 5.5V)
- Commercial and Industrial temperature ranges
- Low-power consumption

CHAPTER 7

DEVICE OVERVIEW

7.1 Pin diagram



This document contains device specific information about the following devices:

• PIC16F873A

• PIC16F874A

• PIC16F876A

• PIC16F877A

PIC16F873A/876A devices are available only in 28-pin packages, while PIC16F874A/877A devices are available in 40-pin and 44-pin packages. All devices in the PIC16F87XA family share common architecture with the following differences:

- The PIC16F873A and PIC16F874A have one-half of the total on-chip memory of the PIC16F876A and PIC16F877A
- The 28-pin devices have three I/O ports, while the 40/44-pin devices have five
- The 28-pin devices have fourteen interrupts, while the 40/44-pin devices have fifteen
- The 28-pin devices have five A/D input channels, while the 40/44-pin devices have eight
- The Parallel Slave Port is implemented only on the 40/44-pin devices

The available features are summarized in Table 1-1. Block diagrams of the PIC16F873A/876A and PIC16F874A/877A devices are provided in Figure 1-1 and Figure 1-2, respectively. The pin outs for these device families are listed in Table 1-2 and Table 1-3. Additional information may be found in the PICmicro® Mid-Range Reference Manual (DS33023), which may be obtained from your local Microchip Sales Representative or downloaded from the Microchip web site. The Reference Manual should be considered a complementary document to this data sheet and is highly recommended reading for a better understanding of the device architecture and operation of the peripheral modules.

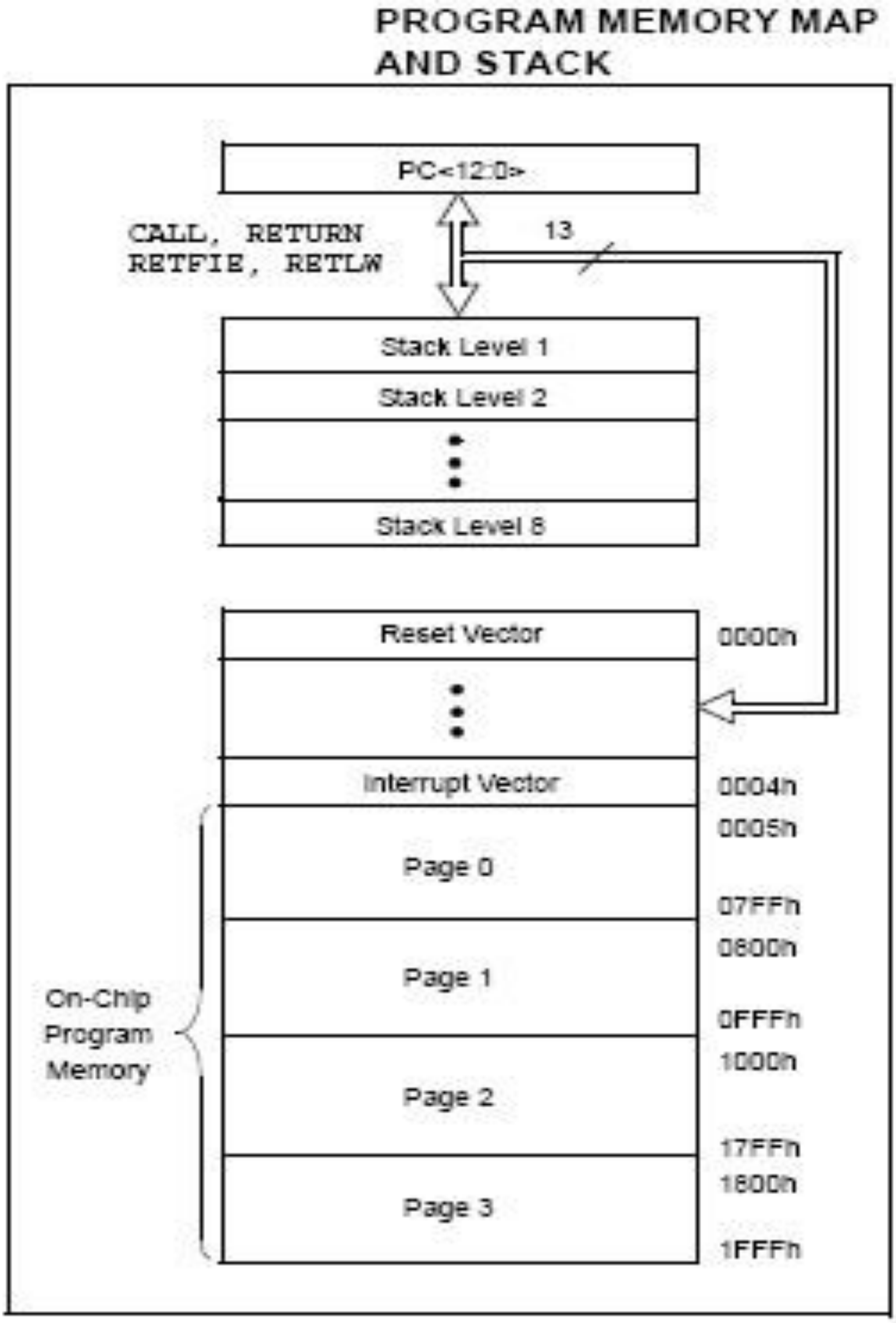
7.2 Memory Organization

There are three memory blocks in each of the PIC16F87XA devices. The program memory and data memory have separate buses so that concurrent access can occur and is detailed in this section. The EEPROM data memory block is detailed in

Section 3.0 "Data EEPROM and Flash Program Memory". Additional information on device memory may be found in the PICmicro® Mid-Range MCU Family Reference Manual (DS33023).

7.2.1 Program Memory

The PIC16F87XA devices have a 13-bit program counter capable of addressing an 8K word x 14-bit program memory space. The PIC16F876A/877A devices have 8K words x 14 bits of Flash program memory, while PIC16F873A/874A devices have 4K words x 14 bits. Accessing a location above the physically implemented address will cause a wraparound. The Reset vector is at 0000h and the interrupt vector is at 0004h.



7.2.2 Data Memory

The data memory is partitioned into multiple banks which contain the General-Purpose Registers and the Special Function Registers. Bits RP1 (Status<6>) and RP0 (Status<5>) are the bank select bits. Each bank extends up to 7Fh (128 bytes). The lower locations of each bank are reserved for the Special

Function Registers. Above the Special Function Registers are General Purpose Registers, implemented as static RAM. All implemented banks contain Special Function Registers. Some frequently used Special Function Registers from one bank may be mirrored in another bank for code reduction and quicker access.

7.3 I/O PORTS

Some pins for these I/O ports are multiplexed with an alternate function for the peripheral features on the device. In general, when a peripheral is enabled, that pin may not be used as a general purpose I/O pin. Additional information on I/O ports may be found in the Mid-Range Reference Manual (DS33023).

7.3.1 PORTA and the TRISA Register:

PORTA is a 6-bit wide, bidirectional port. The corresponding data direction register is TRISA. Setting a TRISA bit (= 1) will make the corresponding PORTA pin an input (i.e., put the corresponding output driver in a HighImpedance mode). Clearing a TRISA bit (= 0) will make the corresponding PORTA pin an output (i.e., put the contents of the output latch on the selected pin). Reading the PORTA register reads the status of the pins, whereas writing to it will write to the port latch. All write operations are read-modify-write operations. Therefore, a write to a port implies that the port pins are read; the value is modified and then written to the port data latch. Pin RA4 is multiplexed with the Timer0 module clock input to become the RA4/T0CKI pin. The RA4/T0CKI pin is a Schmitt Trigger input and an open-drain output. All other PORTA pins have TTL input levels and full CMOS output drivers. Other PORTA pins are multiplexed with analog inputs and the analog VREF input for both the A/D converters and the comparators. The operation of each pin is selected by clearing/setting the appropriate control bits in the ADCON1 and/or CMCON registers. The TRISA register controls the direction of the port pins even when they are being used as analog inputs. The user must ensure the bits in the TRISA register are maintained set when using them as analog inputs.

7.3.2 PORTB and the TRISB Register:

PORTB is an 8-bit wide, bidirectional port. The corresponding data direction register is TRISB. Setting a TRISB bit (= 1) will make the corresponding PORTB pin an input (i.e., put the corresponding output driver in a HighImpedance mode). Clearing a TRISB bit (= 0) will make the corresponding PORTB pin an output (i.e., put the contents of the output latch on the selected pin). Three pins of PORTB are multiplexed with the In-Circuit Debugger and Low-Voltage Programming function: RB3/PGM, RB6/PGC and RB7/PGD. The alternate functions of these pins are described in **"Special Features of the CPU"**. Each of the PORTB pins has a weak internal pull-up. A single control bit can turn on all the pull-ups. This is performed by clearing bit RBPU (OPTION_REG<7>). The weak pull-up is automatically turned off when the port pin is configured as an output. The pull-ups are disabled on a Power-on Reset.

This interrupt can wake the device from Sleep. The user, in the Interrupt Service Routine, can clear the interrupt in the following manner:

a) Any read or write of PORTB. This will end the mismatch condition.

b) Clear flag bit RBIF.

A mismatch condition will continue to set flag bit RBIF. Reading PORTB will end the mismatch condition and allow flag bit RBIF to be cleared. The interrupton-change feature is recommended for wake-up on key depression operation and operations where PORTB is only used for the interrupt-on-change feature. Polling of PORTB is not recommended while using the interrupt-on-change feature. This interrupt-on-mismatch feature, together with software configurable pull-ups on these four pins, allow easy interface to a keypad and make it possible for wake-up on key depression.

7.3.3 PORTC and the TRISC Register:

PORTC is an 8-bit wide, bidirectional port. The corresponding data direction register is TRISC. Setting a TRISC bit (= 1) will make the corresponding PORTC pin an input (i.e., put the corresponding output driver in a HighImpedance mode). Clearing a TRISC bit (= 0) will make the corresponding PORTC pin an output (i.e., put the contents of the output latch on the selected pin). PORTC is multiplexed with several peripheral functions (Table 4-5). PORTC pins have Schmitt Trigger input buffers. When the I2C module is enabled, the PORTC<4:3> pins can be configured with normal I2C levels, or with SMBus levels, by using the CKE bit (SSPSTAT<6>).

When enabling peripheral functions, care should be taken in defining TRIS bits for each PORTC pin. Some peripherals override the TRIS bit to make a pin an output, while other peripherals override the TRIS bit to make a pin an input. Since the TRIS bit override is in effect while the peripheral is enabled, read-modify write instructions (BSF, BCF, and XORWF) with TRISC as the destination, should be avoided. The user should refer to the corresponding peripheral section for the correct TRIS bit settings.

7.3.4 PORTD and TRISD Registers:

PORTD is an 8-bit port with Schmitt Trigger input buffers. Each pin is individually configurable as an input or output. PORTD can be configured as an

8-bit wide microprocessor port (Parallel Slave Port) by setting control bit, PSPMODE (TRISE<4>). In this mode, the input buffers are TTL.

7.3.4.1 PORTD Functions:

Name	Bit#	Buffer Type	Function
RD0/PSP0	bit 0	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 0.
RD1/PSP1	bit 1	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 1.
RD2/PSP2	bit2	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 2.
RD3/PSP3	bit 3	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 3.
RD4/PSP4	bit 4	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 4.
RD5/PSP5	bit 5	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 5.
RD6/PSP6	bit 6	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 6.
RD7/PSP7	bit 7	ST/TTL[1]	Input/output port pin or Parallel Slave Port bit 7.

7.3.5 PORTE and TRISE Register:

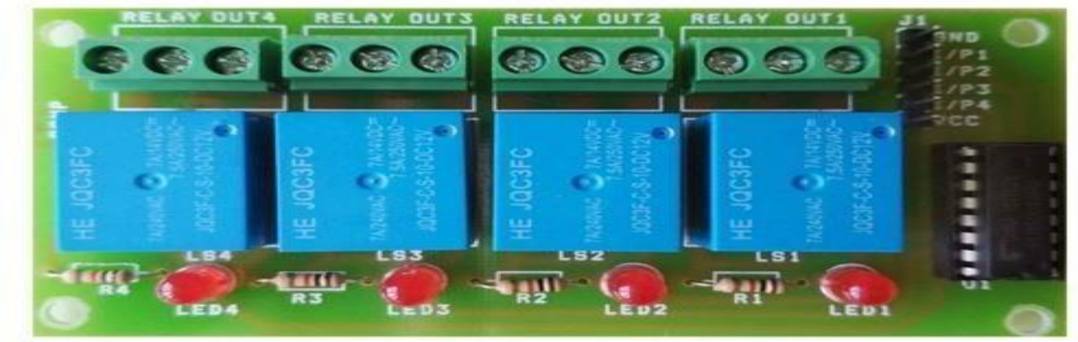
PORTE has three pins (RE0/RD/AN5, RE1/WR/AN6 and RE2/CS/AN7) which are individually configurable as inputs or outputs. These pins have Schmitt Trigger input buffers. The PORTE pins become the I/O control inputs for the microprocessor port when bit PSPMODE (TRISE<4>) is set. In this mode, the user must make certain that the TRISE<2:0> bits are set and that the pins are configured as digital inputs. Also, ensure that ADCON1 is configured for digital I/O. In this mode, the input buffers are TTL.

CHAPTER 8
HARDWARE COMPONENTS

8.1 Relay Board

8.1.1 Description:

Relays are simple switches which are operated both electrically and mechanically. Relays consist of an electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. The main operation of a relay comes in places where only a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. They were used to switch the signal coming from one source to another destination. The high-end applications of relays require high power to be driven by electric motors and so on. Such relays are called contactors.



A relay is an electromechanical switch which is activated by an electric current. A four relay board arrangement contains driver circuit, power supply circuit and isolation circuit. A relay is assembled with that circuit. The driver circuit contains transistors for switching operations. The transistor is use for switching the relay. An isolation circuit prevents reverse voltage from the relay which protects the controller and transistor from damage. The input pulse for switching the transistor is given from the microcontroller unit. It is used for switching of a four device.

8.1.2 Features

- Input voltage: 12VDC
- Driver unit: ULN2003A
- Isolation unit: In4007
- Fast switching
- Motor forward and reverse operation

8.1.3 Applications:

- Ac load Switching applications

- Dc load Switching applications Motor switching applications

8.2 DC MOTOR

8.2.1 Description:

The relationship between torque vs speed and current is linear as shown left; as the load on a motor increase, Speed will decrease. The graph pictured here represents the characteristics of a typical motor. As long as the motor is used in the area of high efficiency (as represented by the shaded area) long life and good performance can be expected. If voltage in continuous applied to a motor in a locked rotor condition, the motor will heat up and fail in a relatively short time. Therefore, it is important that there is some form of protection against high temperature rises. A motor's basic rating point is slightly lower than its maximum efficiency point.

A DC motor converts direct current electrical power into mechanical power. DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field; it experiences a torque and has a tendency to move.
This is known as motoring action. When magnetic field and electric field interact they produce a mechanical force. Thus, a DC motor can be used at a voltage lower than the rated voltage. But, below 1000 rpm, the speed becomes unstable, and the motor will not run smoothly. However, using the motor outside this range will result in high temperature rises and deterioration of motor parts.

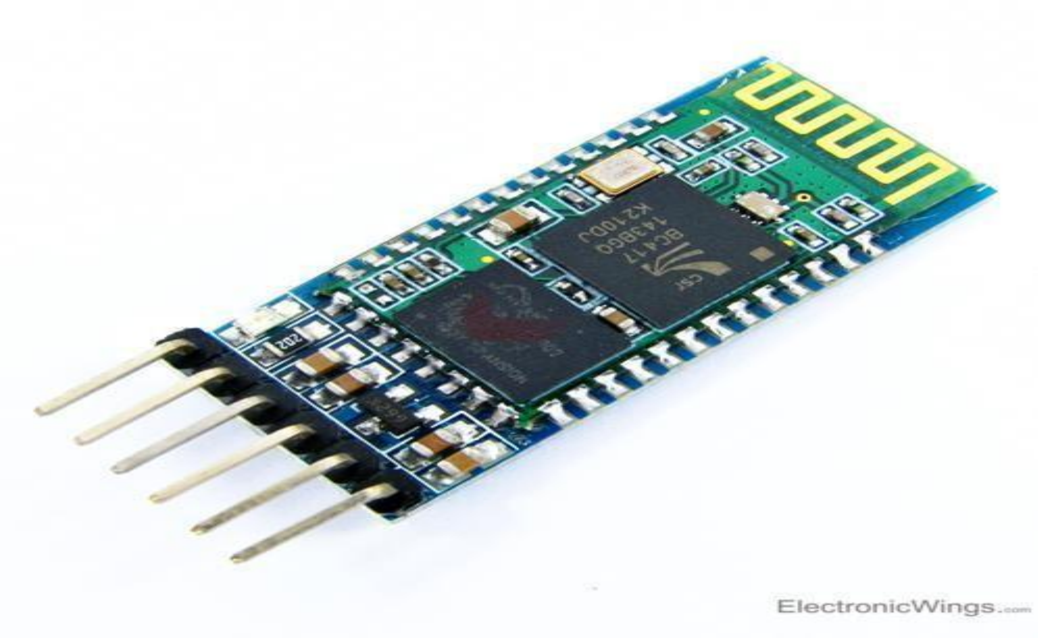
8.2.2 Features:

- Supply voltage: 12VDC
- Very reliable and low cost
- Speed: 1000 rpm

8.3 BLUETOOTH

8.3.1 Description:

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 Blue core 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.

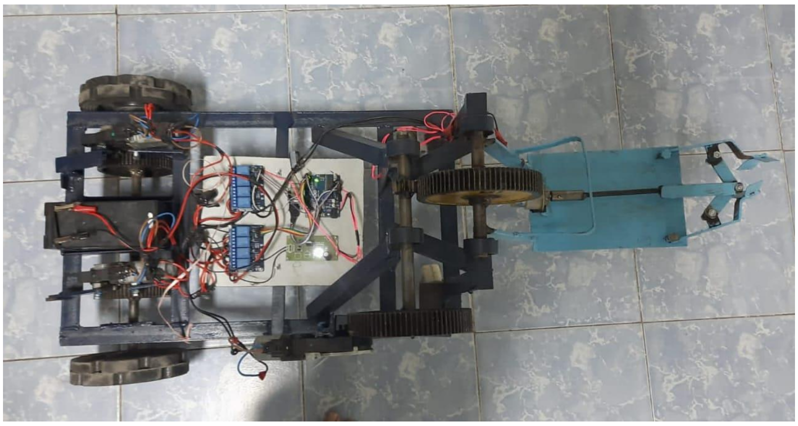


8.3.2 Features:

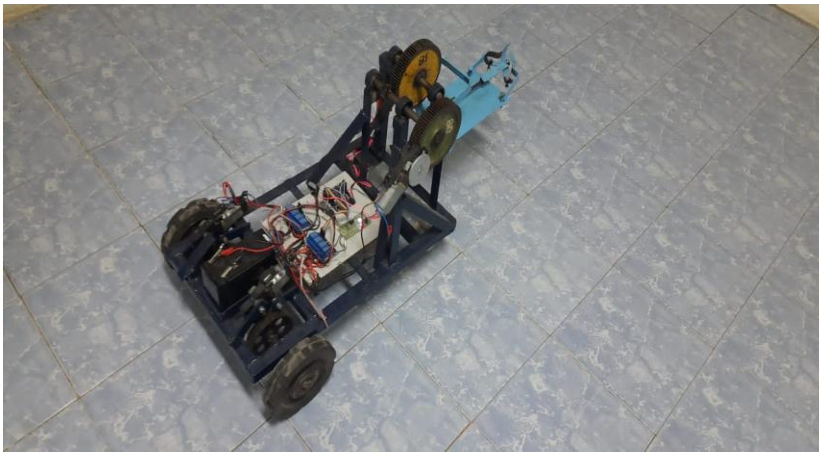
- Typical -80dBm sensitivity
- Up to +4dBm RF transmit power
- Low Power 1.8V Operation ,1.8 to 3.6V I/O
- PIO control
- UART interface with programmable baud rate
- With integrated antenna
- With edge connector

8.4 Switches Position:

Switch-1: Front Movement



Switch-2: Back Movement



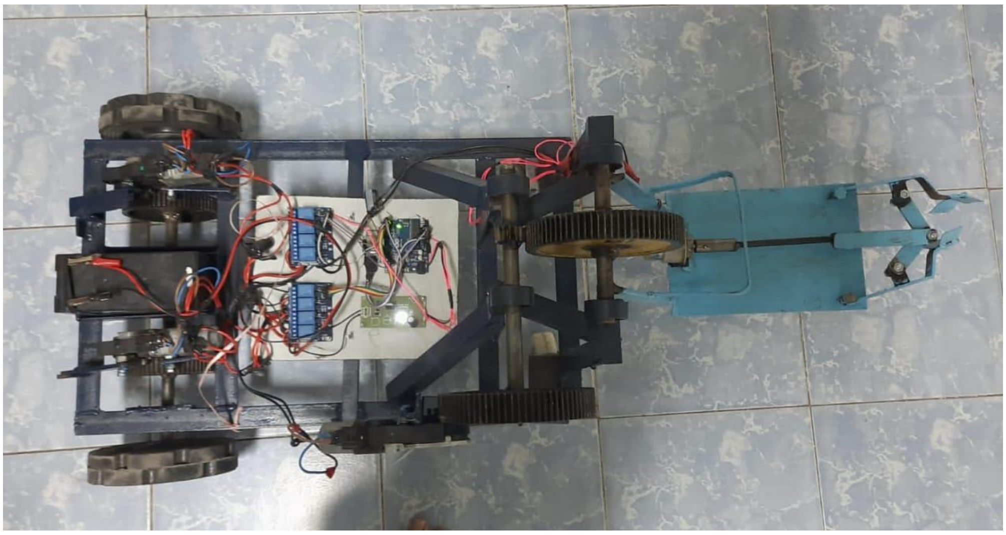
Switch-3: Left Movement

Switch-4: Right Movement

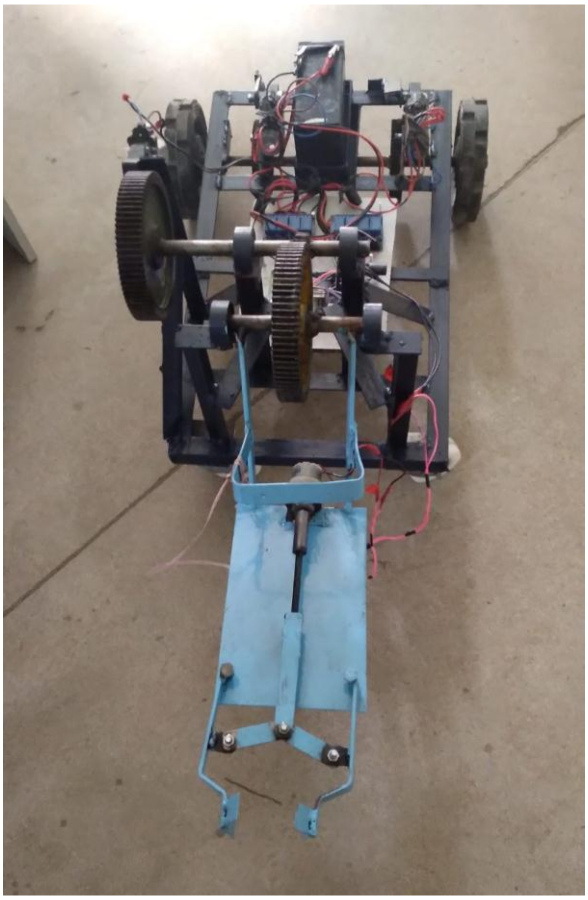
Switch-5: Arm down Movement

Switch-6: Arm up Movement

Switch-7: Gripping Movement



Switch-8: Dropping Movement



CHAPTER 9

SOFTWARE DESCRIPTION

9.1 Software Requirements:

9.1.1 Arduino IDE:

The Arduino integrated development environment (IDE) is a crossplatform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board.

The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. Its products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form or as do-it-yourself (DIY) kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2003 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy, aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats and motion detectors.

The name Arduino comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduin of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

9.1.2 Embedded C:

Embedded C is a set of language extensions for the C programming language by the C Standards Committee to address commonality issues that exist between C extensions for different embedded systems.

Historically, embedded C programming requires nonstandard extensions to the C language to support exotic features such as fixed-point arithmetic, multiple distinct memory banks, and basic I/O operations. In 2008, the C Standards Committee extended the C language to address these issues by providing a common standard for all implementations to adhere to. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces and basic I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C, e.g., main() function, variable definition, data type declaration, conditional statements (if, switch case), loops (while, for), functions, arrays and strings, structures and union, bit operations, macros, etc

CHAPTER 10
CONCLUSION

This study's first findings suggest that most autonomous systems are more flexible than conventional systems. The advantages of less labour costs and limitatiobluens on the number of hours worked each day have greatly improved. Hence, it has enabled automation of the most important working processes. The project offers a low-cost, low-power, and straightforward device control solution. This technology will be heavily utilised in agriculture, gardening, and agronomy universities.

This technique can be used to irrigate gardens, agricultural land, and horticultural areas. In comparison to other types of automation systems, this system is therefore more affordable and effective. High sensitivity sensors can be used in large-scale applications for vast tracts of agricultural land. Farmers will experience less stress as a result.

CHAPTER 11

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