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Robotic Arm

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بسم الله الرحمن الرحيم

يرفعِ الله الَّذين آمنوا منكم والَّذين أوتوا العِلمَ درجاتٍ

صدق الله العظيم

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ABSTRACT

In today's world there is an increasing need to create artificial arms for different inhuman situations where human interaction is difficult or impossible. They may involve taking readings from an active volcano to diffusing a bomb. Here we propose to build a robotic arm controlled by natural human arm movements whose data is acquired through the use of accelerometers. For proper control mechanism and to reduce the amount of noise coming in from the sensors, proper averaging algorithm is used for smoothening the output of the accelerometer. The development of this arm is based on ATmega32 platform along with a personal computer for signal processing, which will all be interfaced with each other using serial communication. Finally, this prototype of the arm may be expected to overcome the problem such as placing or picking hazardous objects or non-hazardous objects that are far away from the user.

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Chapter one

Introduction

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1.1 Introduction

Nowadays, robots are increasingly being integrated into working tasks to replace humans especially to perform the repetitive task. In general, robotics can be divided into two areas, industrial and service robotics. International Federation of Robotics (IFR) defines a service robot as a robot which operates semi- or fully autonomously to perform services useful to the well- being of humans and equipment, excluding manufacturing operations. These robots are currently used in many fields of applications including office, military tasks, hospital operations, dangerous environment and agriculture. Besides, it might be difficult or dangerous for humans to do some specific tasks like picking up explosive chemicals, defusing bombs or in worst case scenario to pick and place the bomb somewhere for containment and for repeated pick and place action in industries. Therefore a robot can be replaced human to do work.

A robot is a machine designed to execute one or more tasks automatically with speed and precision. We need robots because robots are often cheaper to use over humans, in addition it is easier to do some jobs using robots and sometimes the only possible way to accomplish some tasks! Robots can explore inside gas tanks, inside volcanoes, travel the surface of Mars or other places too dangerous for humans to go where extreme temperatures or contaminated environments exist. Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing. Robotic system has been widely used in manufacturing, military and surgery since the robot can perform many advantages and used as the countermeasure for some job that cannot be conduct by the human

Excellently.

Robots are used in different fields such as industrial, military, space exploration, and medical applications. These robots could be classified as manipulator robots and cooperate with other parts of automated or semi-automated equipment to achieve tasks such as loading, unloading, spray painting, welding, and assembling. Generally robots are designed, built and controlled via a computer or a controlling device which uses a specific program or algorithm.

Programs and robots are designed in a way that when the program changes, the behavior of the robot changes accordingly resulting in a very flexible task achieving robot. Robots are categorized by their generation, intelligence, structural, capabilities, application and operational capabilities.

A robotic arm, sometimes referred to as an industrial robot, is often described as a ‘mechanical’ arm. It is a device that operates in a similar way to a human arm, with a number of joints that either move along an axis or can rotate in certain directions. In fact, some robotic arms are anthropomorphic and try and imitate the exact movements of human arms. They are, in most cases programmable and used to perform specific tasks, most commonly for manufacturing, fabrication, and industrial applications. They can be small devices that perform intricate, detailed tasks, small

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enough to be held in one hand; or so big that their reach is large enough to construct entire buildings.

Robotic arms were originally designed to assist in mass production factories, most famously in the manufacturing of cars. They were also implemented to mitigate the risk of injury for workers, and to undertake monotonous tasks, so as to free workers to concentrate on the more complex elements of production. These early robotic arms were mostly employed to undertake simple, repetitive welding tasks. As technologies develop, in particular robotic vision and sensor technology, the role of robotic arms is changing. This article provides a brief overview of Robotic Arms in manufacturing.

1.1.1Robot:

The word "robot" isn't well defined, at least not presently. There's a great deal of debate in the science, engineering, and hobbyist communities about exactly what a robot is, and what it is not. If your vision of a robot is a somewhat human-looking device that carries out orders on command, then you're thinking of one type of device that most people will agree is a robot. It's not a common one and not practical yet, but it makes a great character in science fiction literature and movies. Robots are much more common than many people think, and you're likely to encounter them every day. If you've taken your car through an automatic car wash, withdrawn cash from an ATM, or used a vending machine to grab a beverage, you may have interacted with a robot.

1.1.2 Definition of a Robot: Most people can agree that a robot is a machine that carries out a series of actions automatically and is typically programmed by a computer.
While this is one working definition, it allows for many common machines to be defined as robots, including ATMs and vending machines. A washing machine also meets the basic definition of being a programmed machine; it has various settings that allow the complex tasks it performs to be altered to automatically as it performs a task. No one thinks of a washing machine as a robot.
Additional characteristics differentiate a robot from a complex machine. Chief among these is that a robot is able to respond to its environment to alter its program and complete a task, and it recognizes when a task is complete.
The Definition of a Robot: "A machine capable of responding to its environment to automatically carry out complex or repetitive tasks with little, if any, direction from a human being."

1.1.3 Robotics:

Robotics is a branch of engineering that involves the conception, design, manufacture, and operation of robots. This field overlaps with electronics, computer science, artificial intelligence, mechatronics, nanotechnology and bioengineering.
Science-fiction author Isaac Asimov is often given credit for being the first person to use the term robotics in a short story composed in the 1940s. In the story, Asimov suggested three principles to guide the behavior of robots and smart machines. Asimov's Three Laws of Robotics, as they are called, have survived to the present:
A robot may not injure a human being or through inaction, allow a human being to come to harm.

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A robot must obey the orders given it by a human being except where such orders would conflict with the First Law.
A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.
The field of robotics has greatly advanced with several new general technological achievements. One is the rise of big data, which offers more opportunity to build programming capability into robotic systems. Another is the use of new kinds of sensors and connected devices to monitor environmental aspects like temperature, air pressure, light, motion and more. All of this serves robotics and the generation of more complex and sophisticated robots for many uses, including manufacturing, health and safety, and human assistance.

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1.2 Motivation

Before deciding what project we should do, we were studying real life cases and differentiating between them, like a drone, traffic light system and finally our project robotic arm. We finally decided to pick the robotic arm with the support of the following reasons:

A robotic arm system was developed for use by pepole who had very severe motor disabilities and varying levels of cognitive
Our idea is to make a robotic arm which works on slightly movement of muscles for disabled persons to fulfill the duty to assist in the daily activities likes taking medicine or drinking water.In this project i have used motors that is operated by sensors which will work on the movement muscles of hand.The only goal of the project is to integrate into society and improve the quality of life of persons with disabilities
There are many people who are disabled or they don't arms or limbs especially Soldiers have lost there arm in bomb blast or defusing a bomb or in moving tarps. My hypothesis is that to make a .robotic arm for disabled persons that is controlled through hearing what they want to do
I have figured out that many people or soldiers have lost their arm or limbs in wars or in accidents or in moving traps, as we know that we can't grow our arm once again like starfish we have to create a such a device that acts like a human arm that is controlled with the power of sound.

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1.3 Problem Description

A disability is any medical condition that makes it more difficult for a person to do certain activities or effectively interact with the world around them (socially or materially). These conditions, or impairments, may be cognitive, developmental, intellectual, mental, physical, sensory, or a combination of multiple factors. Impairments causing disability may be present from birth or occur during a person's lifetime. The United Nations Convention on the Rights of Persons with Disabilities defines disability as:

long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder [a person's] full and effective participation in society on an equal basis with others.

Disability is a contested concept, with shifting meanings in different communities.
It has been referred to as an "embodied difference," but the term may also refer to physical or mental attributes that some institutions, particularly medicine, view as needing to be fixed (the medical model). It may also refer to limitations imposed on people by the constraints of an ableist society (the social model); or the term may serve to refer to the identity of disabled people. Physiological functional capacity (PFC) is a measure of an individual's performance level that gauges one's ability to perform the physical tasks of daily life and the ease with which these tasks are performed. PFC declines with advancing age to result in frailty, cognitive disorders, or physical disorders, all of which may lead to labeling individuals as disabled. According to the World Report on Disability, 15% of the world's population or 1 billion people are affected by disability. A disability may be readily visible, or invisible in nature.

1.3.1 objectives

Our goals are creating a fully capable robot to facilitate security {can use as watchman} and monitoring missions
features:

1- Three modes of movement with RGB object Detection .
2- Medicine Recognition .
3- Manage and control whole features with Voice Interface.

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1.4 Problem Solution

There are various ways in which a robotic arm may be controlled. In the past there have been many researchers working to control robotic arm through computer terminals, Joysticks, even interfacing them with the internet so they can be controlled from anywhere in the world.

Usually most of the robotic arms are controlled by a central controller which makes uses of values taken in from the terminal that are entered by the user at the terminal to move the arm to a particular coordinates in space. This makes the control very difficult as the control values of the motors are very difficult to predict to achieve a particular movement. This is easily achieved by our project.

This Project represents a simple accelerometer controlled robotic arm using Atmega32 powered embedded system as the core of this robot and also a Computer to interface the robot with the sensors. The robot does not require training because the robotic arm is fully controlled by the user. This interfacing is done using wired communication but it can easily be switched to wireless with ease.

In this Project, the hardware and software function are combined to make the system reliable. The ATmega32 will be interfacing the robot with the sensor i.e. 3 axis accelerometer and the actuators i.e. servo motors which will control the movement of the robot respectively. The chapter that follows describe the hardware , which is followed by the description of the software being used describes the implementation of the project and concludes the discussion followed by the future scope of the project.

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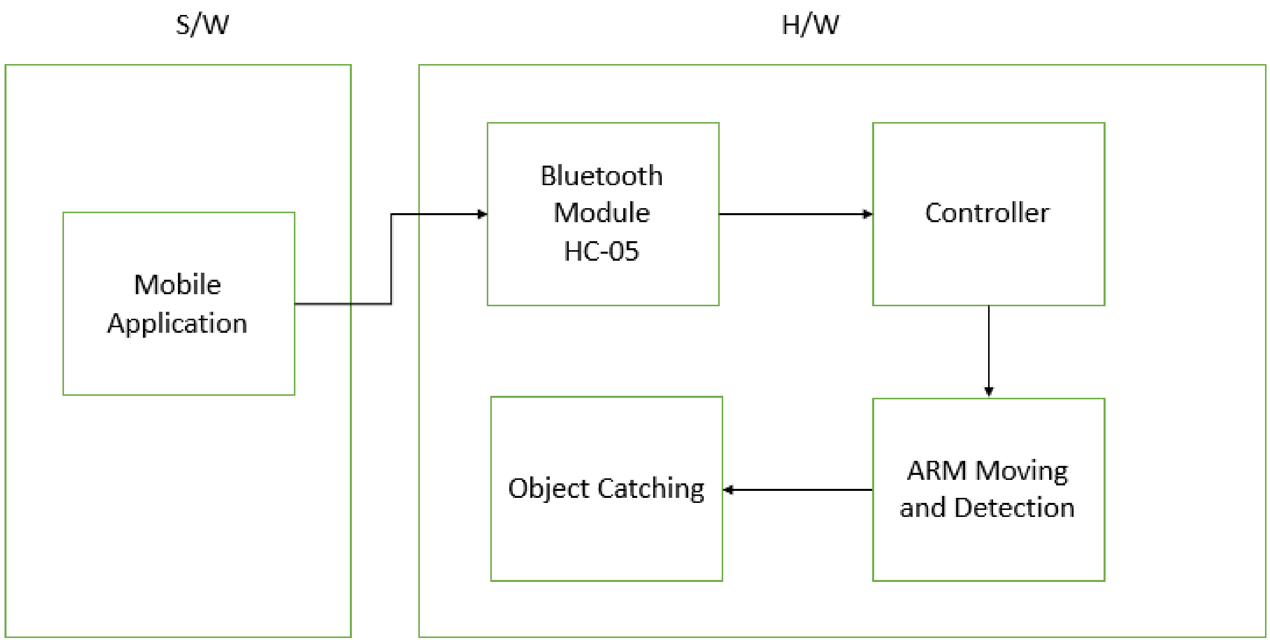

Block Diagram about the Process of Robotic Arm:

Explanation :

We get data from user by MIC via Mobile Application then, the mobile application converts it to text then, sends the data via Bluetooth (on Mobile) to Bluetooth Module (HC-05).

The Microcontroller receives data via USART then, takes a decision according to controller process and starts detecting object then, catch it.

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Chapter two

Robotic

ARM

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2.1 Introduction:

The development of modern robotics was precipitated by the advent of steam power and electricity during the Industrial Revolution. A growing market for consumer products droves engineers to devise ways of producing automatic machines to speed up production, do tasks that humans could not do, and to replace humans in dangerous situations. In 1893 Canadian professor George Moore produced "Steam Man," a prototype for a humanoid robot made of steel and powered by a 0.5 horse-power steam engine. Essentially a gas boiler housed in what looked like a mechanical suit of armor, it could walk independently at a rate of 9 miles per hour (14.5 kph) and pull light loads. In 1898 inventor Nikola Tesla (1856-1943) demonstrated a model for a remotely operated submersible boat at Madison Square Garden. Tesla also wrote that he believed it possible to someday build an intelligent, autonomous humanoid robot. Tesla's ideas were not taken seriously until well into the twentieth century. In fact, the robotics industry as we know it emerged only around the mid-twentieth century. Once research and development teams began to work in earnest, however, robots were integrated into manufacturing and gradually adapted to the military, aeronautics and space, medical, and entertainment industries.

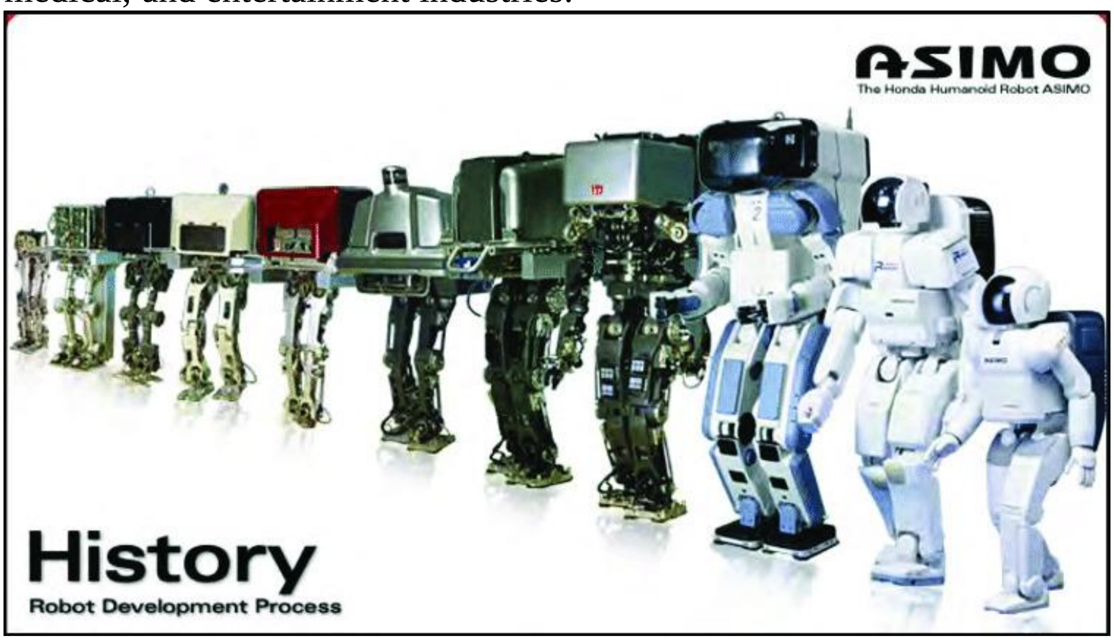

Fig 2.1 about the History of Robotics

By the 1950s engineers were developing machines to handle difficult or dangerous repetitive tasks for both defense and consumer manufacturing—particularly the booming automotive industry. Because robots were meant to replicate the pattern of movement that a human would make while lifting, pulling, pressing, or pushing, designs were based upon the anatomical structure and movement of a human arm. These were modified versions of the first patents for robotic arms filed over a decade earlier. For example, patents for both the "Position Controlling Apparatus," filed in 1938 by Willard V. Pollard, and a spray-painting apparatus by Harold A. Roselund, filed in 1939, were modeled on human shoulder-arm- wrist configuration and dexterity. Roselund's design patent was granted to the DeVilbiss Company, which would later become a major supplier of robotic arms in the United States. These early prototypes were not mass produced. However, once electronic

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controllers came into use after the Second World War, similar but more efficient designs were developed, including the first computer-controlled revolute arms from Case Western Reserve and General Mills in 1950, and a complex, hydraulically powered robotic arm by the British inventor Cyril W. Kenward, who filed his patent in 1954 and published it in 1957.

"Planetbot," one of the first commercial service robots in production, was a hydraulically powered robotic arm first used by a division of General Motors in the production of radiators during the mid-1950s. Eventually, approximately eight Planetbots were sold. The company claimed its robot could easily perform 25 individual movements and could be reset to perform a different set of operations in only minutes. However, this early model proved unsuccessful because it was controlled by a cumbersome mechanical computer, and it behaved erratically when the hydraulic fluid was cool. By the 1980s the Planet Corporation had developed a more sophisticated and efficient hydraulic arm, which has been successfully used for forging operations.

"Unimate" designed by George Devol and patented by Devol and Joe Engelberger, was originally used to automate the production of television picture tubes. The movement of Unimate's 4000-pound (1,816 kg) arm was controlled by commands stored on a magnetic drum. In 1962 it was integrated into General Motors Corporation production to sequence and stack hot, die-cast metal components. After the bugs were worked out of its design, Unimate became a popular feature in assembly lines. Of the approximately 8500 machines originally sold, more than half of them were used in automotive manufacturing plants. Today, there are approximately eight models of Unimate available, boasting payloads of from 50 to 500 pounds (23 to 227 kg). They have been adapted to such applications as material handling, spot welding, die casting, and machine tool loading, with an advertised 98 percent reliability rate.

Finally, as with technology in general, corporate and industrial developers and independent inventors alike have enthusiastically adapted robotics to the entertainment and public relations industries. Corporations like Sony are beginning to market robotic pets that look and behave like cats or dogs, for people with allergies, or those who don't have the time to take care of a real pet. Since the 1980s novelty robots have appeared at trade shows, conference openings, and in safety programs at grammar schools.

Robotics applications

• Medical: Robots in medicine perform a wide range of tasks, including performing surgery, assisting in rehabilitation, or automatically disinfecting hospital rooms and surgical suites

• Industrial: Robots were quickly put to use in industry, beginning with “Unimate”, a robot designed by George Devol in 1959 for General Motors. Considered to be the first industrial robot, Ultimate was a robotic arm used to manipulate hot die-cast parts in automobile manufacturing, a task that was dangerous for humans to perform.

Consumer: Perhaps the best-recognized household robot is the Roomba vacuum cleaner, which automatically cleans the floors around your house. Along the same line are a number of robotic lawn mowers that keep your grass clipped for you.

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Robots you didn’t know were robots: The list contains robots you come across every day, but probably don’t think of as robots: automatic car washes, speeding or red-light cameras, automatic door openers, elevators, and some kitchen appliances

Review about robotic arm
The first robotic arm, which Devol and Engleberger called the Unimate , was made in 1959. In 1961, Devol was awarded a patent for his robot invention and he and Engelberger established the world’s first robot company, Unimation—an abbreviation of the term “universal automation.” The first robot was installed at a General Motors plant in New Jersey to assist a hot die-casting machine. Unimation went on to develop robots to assist with welding and other applications in the fast-growing automotive industry. By 1966, Unimation granted licenses to Nokia in Finland and Kawasaki Heavy Industries of Japan to manufacture and market the Unimate, expanding the use of programmable robot arms into a global market.
hile the first robot was invented as the general-purpose machine to move materials, Engelberger and Devol recognized the device’s value to manufacturing. The automotive industry is still the largest market for robotic automation, but other industries - including electronics assembly; life sciences; food and beverage; and metal and plastics manufacturing are rapidly deploying robots as part of a push towards automation.

Engelberger was also interested in the many ways that robots could be used in the service of humanity. For example, he was especially interested in how robotics could be leveraged in the service industries and healthcare.

2.2 Arm Applications:

Researchers have classified the robotic arm by showing its industrial application, medical application, and technology, etc. It has been first introduced in the late 1930s by William Pollard and Harold A. Roseland, where they developed a sprayer that had about five degrees of freedom and an electric control system. Pollard's was called “first position controlling apparatus.” William Pollard never designed or built his arm, but it was a base for other inventors in the future.
Other robotic arms were invented in 1961 by Unimate, evolving to the PUMA arm. In 1963, the Rancho arm was designed, along with many others in the future. Even though Joseph Engelberger marketed Unimate, George Devol invented the robotic arm. It focused on using Unimate for tasks that are harmful to humans. In 1959, a 2700-pound Unimate prototype was installed at the General Motors die-casting plant in Trenton, New Jersey. The Unimate 1900 series became the very first produced robotic arm for die-casting. During a very short period of time, it had produced at least 450 robotic arms were being used. It still remains one of the most significant contributions in the last one hundred years. As years went by, technology seemed to evolve, helping to build better robotic arms. Not only companies invented different robotic arms, but so

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did colleges.
In 1969, Victor Scheinman from Stanford University invented the Stanford arm, where it had electronically powered arms that could move through six axes. Marvin Minsky, from MIT, built a robotic arm for the office of Naval Research, possibly for underwater explorations. This arm had twelve single degree freedom joints in this electric-hydraulic- high dexterity arm. Robots were initially created to perform a series of tasks that humans found boring, harmful, and extremely hard.

1- Arms for automotive manufacturing

Without the mechanical arm, the production of cars would be extremely difficult. This problem was first solved in 1962 when the first mechanical arm was used in a “General Motors” factory. Using this mechanical arm, also known as an industrial robot, engineers were able to achieve difficult welding tasks. In addition, the removal of die-castings was another important step in improving the abilities of a mechanical arm. With such technology, engineers were able to easily remove unneeded metal underneath mold cavities. Stemming off these uses, welding started to become increasingly popular for mechanical arms.

2- Surgical Arms

A critical requirement of an IoT is that the things in the network must be connected to each other. IoT system architecture must guarantee the operations of IoT, which connects the physical and the virtual worlds. Design of IoT architecture involves many factors such as networking, communication, processes etc. In designing the architecture of IoT, the extensibility, scalability, and operability among devices should be taken into consideration. Due to the fact that things may move and need to interact with others in real-time mode, IoT architecture should be adaptive to make devices interact with other dynamically and support communication amongst them. In addition, IoT should possess the decentralized and heterogeneous nature.

a. Rover Arms

In space, NASA used a mechanical arm for new planetary discoveries. One of these discoveries came from sending a rover to another planet and collecting samples from this planet. With a rover, NASA can just keep the rover on its designated planet and explore all they want. Mechanical

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arms are also attached to the ships that are acting as satellite stations in Earth's atmosphere because they help grab debris that might cause damage to other satellites. Not only that, but they also keep astronauts safe when they have to make a repair to the ship or satellite. Now, space isn't where all the rover's with mechanical arms are. Even the SWAT team and other special forces use these rovers to go into a building or unsafe area to defuse a bomb, plant a bomb or repair vehicles.

b. Everyday Mechanical Arms

Every day a person might be using a type of mechanical arm. Many mechanical arms are used for very ordinary things like being able to grab an out of reach object with the pincer mechanical arm. A simple system of 3 joints squeezes and releases motion causing the pincer to close and finally grab a desired object. Even the objects that might seem super simplistic like tweezers can be classified as a mechanical arm. This simple object is being used millions of times daily all thanks to the help of an engineer making a simple, but great design.

3- Prosthetics Arms

Prosthetics may not seem like a mechanical arm, but they are. It uses hinges and a wire harness to allow an incapable being to perform everyday functions. They have started creating arms that take a structure of a human arm and even though it looks like a skeletal metal arm, it moves like a normal arm and hand. This arm was made by Johns Hopkins University in 2015. It has 26 joints (way more than the old outdated arms) and is capable of lifting up to 45 pounds. This arm has 100 sensors that connect to the human mind. These sensors allow the person with the arm to move the arm like it was just another part of his or her body. People who have used this new prosthetic can say that they have actually been able to feel the texture, ultimately making prosthetics a huge part of the mechanical arm category.

4- **Before the modern Era**:

The history of prosthetic limbs came to be by such great inventors. The world's first and earliest functioning body parts are two toes from Ancient Egypt. Because of their unique functionality, these toes are an example of a true prosthetic device. These toes carry at least forty percent of the body's weight. Most prosthetic limbs would be produced after there is intensive studying of a human being's form by using modern equipment. Prosthetic limbs were used during the war too, including during the late 1480s.

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A German knight, who served with the Holy Roman Emperor Charles V, was injured during the war. Even though prosthetic limbs were expensive, this particular limb was manufactured by an armor specialist. Soldiers were allowed to continue their career because of prosthetics. The fingers could grasp a shield, hold reins to horses, and even a quill when drafting an important document.

5- **Modern Era**:

As time passed, limb design started to focus on people's specialties as well. For example, a pianist would need a different type of mechanical arm than others. Their limbs would be widespread and their middle and ring fingers would be smaller than normal. In addition, an arm design of padded tips on the thumb and little finger would allow a pianist to span a series of notes while playing their instrument.

Technology for the prosthetic limbs kept evolving after World War I. After the war, laborers would return to work, using either legs or the arms because of its ability to grip objects. This is one of the designs that remains unchanged over the past century. People with such prosthetics would do everyday things like driving a car, eating food, and much more.

Nowadays as constant improvements were being made there is more modifications and advancements in robotic Arms:

6- **Muscle tissue for mechanical Arms:** The National University of Singapore has started making artificial muscle tissue to be able to be placed in mechanical arms to be able to help people pick up heavy loads. This artificial tissue can pick up to 500 times its own weight. Depending on how much of the tissue engineers place in the mechanical arm, the greater lift strength the arm has. A regular human well-grown adult weighs around 160 to 180 pounds. Now, a person weighing that much could be able to lift an object that weighs around 80,000 pounds. This would make construction sites a lot safer being able to just walk up with the construction supplies instead of using a crane that can collapse due to harsh weather. Soon, utility vehicles for construction may be a thing of the past.

7- **Sensor Mechanical Arms:** New mechanical arms being used for prosthetics are starting to gain sensors that, with the help of a chip attached to one's spinal cord, allows a person to move the arm. Since sensors can easily be programmed to have a higher sensitivity to anything the sensor touches, people with prosthetic arms will also be able to feel the object

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they are touching. With this, a person could feel even the slightest vibration. This could be a danger and a good thing. It can danger the human because if dealt with to much pressure the person with the prosthetic can suffer severe pain. Besides actually obtaining the sense of touch back, one could also sense more awareness of incoming danger.

8- **Lifelike Mechanical Arms:** Lifelike mechanical arms, along with ordinary human arms, are so similar that it may be hard to distinguish between the two. The reason for this is because a spray, that places a coat on the prosthetic arm, makes the arm look real. This futuristic fantasy is beginning to become more of a reality. Scientists are even starting to create sleeve type artificial skins to keep a prosthetic arm looking like a normal arm. This will allow people with prosthetics to not feel self-conscious of their robotic arm.

2.3 Mechanism of ARM

This is the illustration of the design and fabrication of a four degree of freedom autonomous robotic arm using Digital image processing. The robotic arm boasts a high performance, RISC architecture-based microcontroller manufactured by Atmel, the AtMega32. Control of the robotic arm has been achieved successfully using four servo motors, each of which incorporates high resolution quadrature encoders. The robotic arm is equipped with a high-resolution digital camera. This camera transmits real time video to a Pentium based processor. The image processing module searches the video stream for predefined templates and calculates the coordinates of the object to grasp and transmits them serially to the microcontroller. The microcontroller implements inverse kinematics algorithms and then actuates the respective motors through angles so as to reach the coordinates desired in the most efficient manner. The motors are actuated using the internal PWM channels of the microcontroller and power amplifiers using efficient Mosfets. The robotic arm also has the provision of being controlled without the camera relying on user input for the starting and terminating points. These coordinates are fed to the controller directly using voice input through mobile.

application and LCD module eliminating the Pentium processor. Thus, even without a vision system the robotic arm may be defined

as being autonomous. The end effector is a two fingers gripper.

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1- Robotic Arm

The mechanical design of the robot arm is based on a robot manipulator with similar functions to a human arm. Robotic arm system often consists of links, joints, actuators, sensors and controllers. The links are connected by joints to form an open kinematic chain. One end of the chain is attached to the robot base, and another end is equipped with a tool (hand, gripper, or end-effectors) which is analogous to human hand in order to perform assembly and other tasks and to interact with the environment. There are two types of joint which are prismatic and rotary joints and it connect neighboring link.

The links of the manipulator are connected by joints allowing rotational motion and the links of the manipulator is considered to form a kinematic chain. Figure 2 shows the Free Body Diagram for mechanical design of the robotic arm. A robotic arm with only four degrees of freedom is designed because it is adequate for most of the necessary movement. At the same time, it is competitive by its complexity and cost-saving as number of actuators in the robotic arm increases with degrees of freedom. In a robotic system, the number of degrees of freedom is determined by the number of independent joint variable.

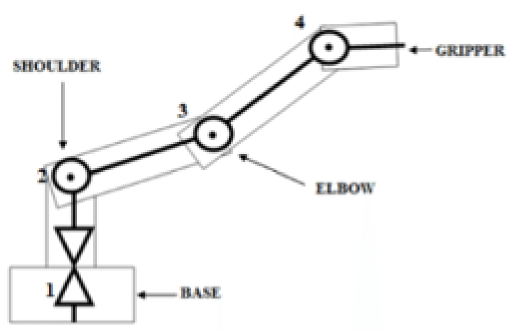

Fig 2.2 Free body diagram of the robotic arm

The robotic arm has four servo motors, each motor for one DOF and the motors operate with 6 volts. There are four rotating DOF in the arm and their ranges of rotation are indicated in the Table

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Table 1.Number of degrees for specific DOF.

Degrees of Freedom(DOF)	Degrees
1	180
2	90
3	90
4	90

The area that the gripper so called as end-effecter can reach is known as robot workspace. It depends on the DOF and translation limitation, the arm link lengths, the angle at which something must be picked up at and robot configuration. Figure 2 shows the typical work region of the robotic arm with four degree of freedom (4 DOF).

This is a support for the robotic arm and will be fixed at base it is required to support large load applied by the object to be lifted, servo motor and link. This limb is designed for rotational purpose and also the motor for up-down motion of the robotic arm. he overhanging part is where the wires will be connected and then actuated by the servo motor at the base. Motor housing is nicely fit into the hollow part of the limb. This is also the linkage to the next part for up-down motion. The following limb shown below is designed with maximum extending shape as well as the area for motor to be fit in. The lower part is connected to the previous limb using a connecting wire. Actuators are devices that cause rotary joints to rotate about their motion axes, or drive prismatic joints to slide along their motion axes. Generally, there are three types of fundamental actuating systems used in robot systems: hydraulic actuating systems, pneumatic actuating systems, and electrical actuating systems. In our design, we are using electrical actuating systems. DC motors and stepper motors are used to actuate the movement of the robotic arm. This is because this system can be controlled easily and the servo motor is able to give a fast response, high accuracy, included encoders which automatically provide feedback to the motors and adjustability of position accordingly. This type of actuator is suitable for small robots. However, the disadvantages of the servo motor is that rotation range is less than 180o span, thus the region reached by the arm and possible positions are greatly decrease. As we have 3 joints in the robotic arm, we need to set up 3 controllers to control all joint actuators. electing suitable motor for the application is crucial in the design stage which decision is made based on torque and the speed of the motor. Force calculation of joint ensures that the motor chosen can support the weight of the robotic arm and also the load which need to be carried. Servo motors is recommended when high torque and precise speed desired by the user. For only positioning without requiring a high torque, stepper motors are used in the application. Torque is the tendency of force to rotate an object about an axis. Mathematically, torque is defined as the cross product of the lever-arm distance and force, which tends to produce rotation i.e. (T=F*L Nm) Where, F=force acting on the motor L=length of the shaft Force, F is given by,

F=m*g N

Where, m=mass to be lifted by the motor

g=gravitational constant=9.8 m/s

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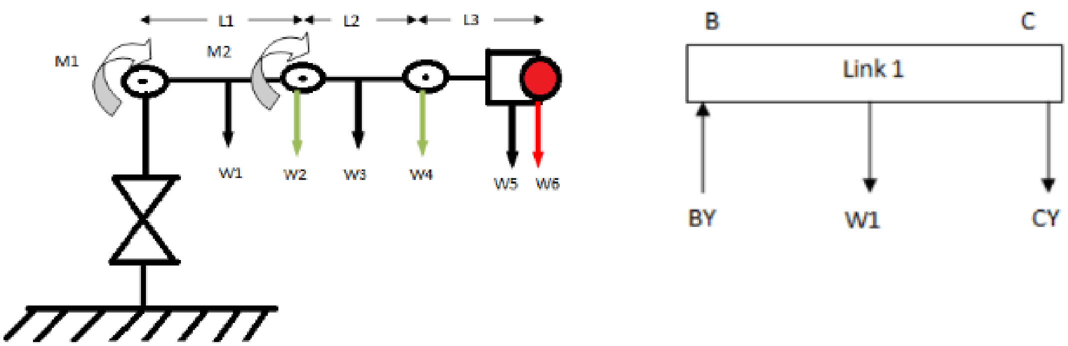

Fig 2.3 View of loads/moments on joints (right) and force diagram of link 1

2- Electrical signal

The electrical circuit was design to be neat and efficient based on the output given out by Microcontroller. The below items are the total of outputs used in Microcontroller and connected by wrapping wires.

1. 2 Ground pins (left and right side of the board)
2. Power supply of 3.33V for powering Bluetooth module
3. Digital output 0 to for Receiving signal from Bluetooth module
4. Digital output 1 to for Transmitting signal to Bluetooth module
5. Digital output 4 to for Gripper servo
6. Digital output 5 to for Elbow serv
7. Digital output 6 to for Shoulder servo
8. Digital output 7 to for Base(rotation) servo
9. Power Supply for Microcontroller
10. Power Supply for servo

The electrical circuit was design so that the whole wiring system will look neat and more organize. Besides that, by wrapping the wire all cross over connection are only not visible anymore as they are located below the donut board circuit. For the power supply, only Bluetooth module was powered by Microcontroller as there are available source from it. The only separated power source is the servos which they require at least I A in order to operate the whole system. This was overcome by supplying them with the power source from power banks or direct current which are 5V optimum. Using the circuit above allow the whole electrical system to be smaller, compact, neat and easier to plug

Robotic arm communicated with user via Bluetooth to the Bluetooth module installed on the control system of robotic arm. When a user slides each button on the application, input signal or controlling signal is given from the paired Android smart phone and then sent via Bluetooth to the robotic arm.

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The data from the smart phone is sent in the form of ASCII format in order to be received by the Bluetooth module and passed on to Arduino for further operation. The Arduino detected the input of signal and converted them into command, the robot then checked the command with its previously defined commands and the servo motors acts accordingly depending on the command received from the microcontroller by moving forward, backward, left, right or to stop. Thus, a smart phone Android operated robot is created to perform lifting tasks.

2- Test for Development

In order to validate the robot arm and its component, few tests were carried out which included testing both components and the overall robotic arm system. Figure 13 shown tests conducted on the robotic arm have been carried out in laboratory. By varying the position of the objects which need to be lifted by the robotic arm, the servo motor movement range is tested. Different direct impulses to each servo motor are sent by giving a command through smart phone. This can help to verify the response of the servo motor whether it can move to the right position according to the command given by the user. This process occurred when servo motors interpreted the signal from microcontroller through encoder which resulted in the rotation to the desired position. The initial and final position are marked to rate the accuracy of the actuator.
For overall system performance, maximum load which able to be lifted by the robotic arm is determined using different weights. During the test, the robotic arm picked up the weight and moved it to a particular position.

3- Final Position

Result of the robotic arm of lifting with different weight is presented in this section. The load to be lifted in this experiment is a sand bag with different weight. The robotic arm is commanded to lift the sand bag and relocate it to a specific position. The experiment is started to examine the accuracy of positioning with a variation in weight of a sand bag which is in the range of **W** grams to **W** grams, the load with **W** grams act as a reference. The precision of the robotic arm to lift different weights is recorded in the table below. From the data obtained, the robotic arm can lift **W** grams as expected result in this project. However, the movement of robotic arm is not smooth when it lifted **W** grams due to lack of strength in the linkage that made up of galvanized wire with 1mm diameter. This problem can be solved by using a high strength linkage which made up of steel.

4- Time Duration

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A complete lifting cycle can be done at **T** seconds and there is an insignificant difference of time taken for various weights. The furthest pickup point was only **L** cm is because the inconsistency length and not rigidity of it. This causes some stretches or expanding on the galvanized wire linkage. As for its rotation angle, it can rotate up to **θ**; with range from **θ** to **θ** this rotation is expected as the rotation linkage is unstable due to the elevation of the servo motor. The elevation is a must to meet up the height of the motor. Total precision of **θ** is only possible if the whole linkage is in one piece and not connected using screw, bolts and nuts. The final position of the robotic arm varies as the weight increases. Again, the reasons for its imprecision are caused by two factors. The first factor was the size of the weight which is not compatible and not suitable for the gripper due to its smooth surface. Secondly, the linkage bends a lot when gripping the Wg weight. This shows the lack of strength of the galvanized wire which causes imprecision for the robotic arm. The lifting of the weight shows a good result nevertheless as is it able to lift a Wg as calculated. This robotic arm will be able to lift a better weight and more precise with a better designed linkage for it. The robotic arm was able to reach a good precision on its timing is because the usage of servo motor. Servo motors moves according to the input receive. The programming was set to perform the task within the given time for example: delay (T) which indicate the delay for T milliseconds. This shows that the robotic arm will perform the task within T milliseconds.

the further development, the robotic arm can be situated on a mobile platform with 4 wheels to allow portability and navigation. Design of a universal gripper is interesting because it can lift different shapes of objects. Robotic arm has sensors to detect the position of the objects and the whole process is automated and it can also communicate with user through networking

Fig 2.4 Picture of the project

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Chapter three

Hardware

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3.1 Introduction

In this chapter we will explain Microcontroller, Tools, Servo Motor and Raspberry pi.
A microcontroller is an electronic device belonging to the microcomputer family. These are fabricated using the VLSI technology on a single chip. There are microcontrollers available in the present market with different word length starting from 4 bit, 8 bit, 64 bit to 128 bit. This chapter is about microcontrollers, their architecture, and various features. In a broader sense, the components which constitute a microcontroller are the memory, peripherals and most crucially a processor. Microcontrollers are present in devices where the user has to exert a degree of control. They are designed and implemented to execute a specific function such as displaying integers or characters on an LCD display module of a home appliance. Application of microcontrollers is myriad. In simpler terms, any gadget or equipment which has to deal with the functions such as measuring, controlling, displaying and calculating the values consist of a microcontroller chip inside it. They are present in almost all the present day home appliances, toys, traffic lights, office instruments and various day-to-day appliances.

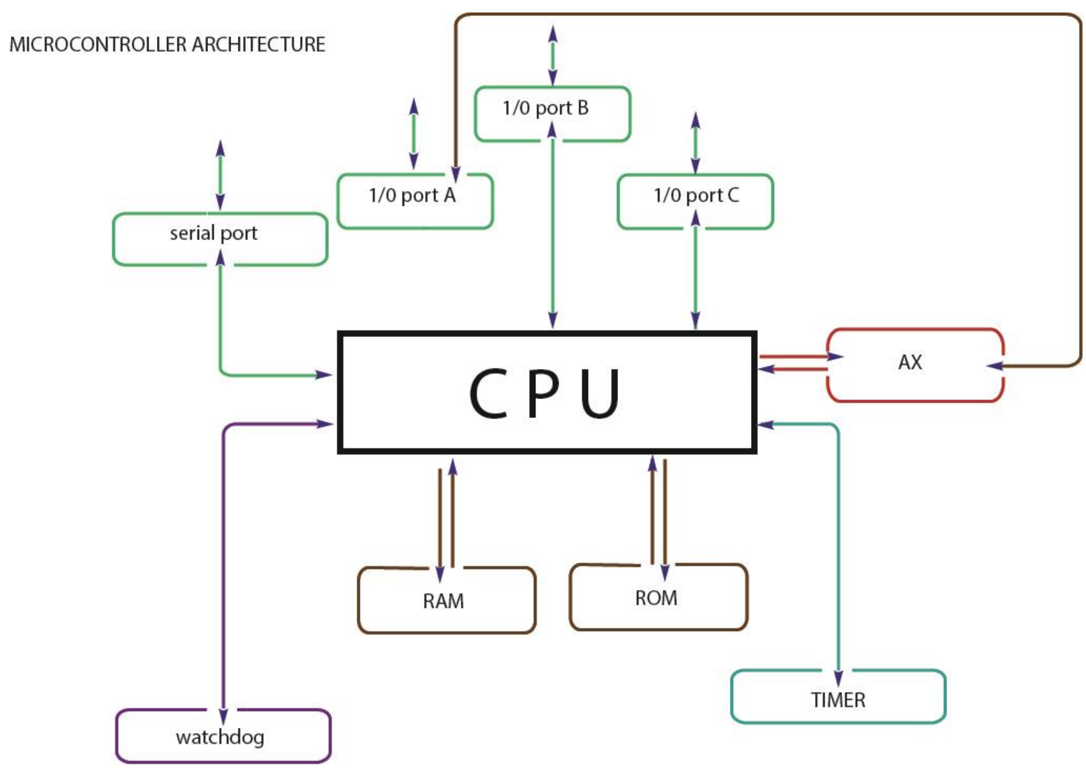

Fig 3.1 Microcontroller Architecture

The most important part of a microcontroller is a central processing unit with a word length ranging from 4-bit to 64-bit and in some modern microcontrollers the word length goes even beyond the

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limit of 64-bit. A timer is one other constituent of a microcontroller. There is a watchdog timer. Memory spaces such as RAM, ROM, EEPROM, EPROM are there to store data and programs. For data storage, volatile memory RAM is used while for the program and operating parameter storage ROM and other memory spaces are used.

CPU: Being regarded as the brain of the microcontroller, central processing unit fetches, decodes and executes the instructions. It coordinates various activities taking place in the microcontroller.

I/O ports: There are several parallel input/output ports in a microcontroller. They are used to interface various peripherals such as printers, external memories, LEDs and LCDs to the microcontroller. Apart from parallel ports, there are serial ports to interface serially connected peripherals with the microcontroller.

Memory: As in the case of a microprocessor, a microcontroller has spaces for memories such as RAM, ROM including EEROM and EPROM. It also allocates a certain amount of flash memory to store program source code.

Timers and counters: These are the fascinating constituent parts of a microcontroller. Timers and counters are used in operations which include modulation, clock functions, frequency generation and measuring and pulse generation.

Analog to digital converters (ADCs): Such converters are useful while converting the output of a sensor which would be in analog form.

Digital to analog converter (DAC): The working of a DAC is just the reverse of an analog to digital converter. As it is obvious, the output will be an analog signal which can be used to control the analog peripherals such a motor.

3.2 Features of a Microcontroller

- The main advantage of a CISC (complex instruction set computer) architecture, with which the modern microcontrollers are built, is the macro-type instructions. A macro instruction can be used in a program replacing a number of instructions.
- Latest microcontrollers are operated at lesser power consumption. Usually, they can support a working voltage of 1.8-5.5 V.
- Advanced memory is another feature of a microcontroller. Use of ROM memories like EEPROM and EPROM (flash memory) make it more reliable and user-friendly. While EEPROM is a relatively slow memory, EPROM is faster. Fact that it allows more erase/write cycles also makes it more usable.

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3.3 History of AVR Microcontrollers:

AVR is a family of microcontrollers developed since 1996 by Atmel, acquired by Microchip Technology in 2016. These are modified Harvard architecture 8-bit RISC single-chip microcontrollers. AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time.

AVR microcontrollers find many applications as embedded systems. They are especially common in hobbyist and educational embedded applications, popularized by their inclusion in many of the Arduino line of open hardware development boards.

So according to the following features we preferred to use ATMega 32 and this is a type of avr microcontrollers:

3.4 The main features of ATmega32 are :-

- 32K bytes of In-System Programmable Flash Program memory with Read-While-Write capabilities
- 1024 bytes EEPROM
- 2K byte SRAM
- 32 general purpose I/O lines
- 32 general purpose working registers
- a JTAG interface for Boundaryscan
- On-chip Debugging support and programming
- 3 flexible Timer/Counters with compare modes
- Internal and External Interrupts
- a serial programmable USART
- a byte oriented Two-wire Serial Interface
- an 8-channel, 10-bit ADC
- a programmable Watchdog Timer with Internal Oscillator
- an SPI serial port
- 6 software selectable power saving modes

`3.4.1 There are thousands of applications for ATMEGA32.

- Temperature control systems.
- Analog signal measuring and manipulations.
- Embedded systems like coffee machine, vending machine.
- Motor control systems.

`

- Digital signal processing.
- Peripheral Interface system

the difference between atmega32 and atmega328 (Used in Arduino):

One **difference** is that the **ATmega32** has JTAG; **ATmega328P** has not. Despite a similar name, the chips are quite different. 32u4 for examle has USB built in. 328PB has more 16-bit Timer/Counters.

3.4.2 Comparison Between Embedded Software Development Tools:

1- Eclipse

Initially, the Eclipse integrated development environment was created for Java applications, and now it is the most widely used solution by Java programmers. Nevertheless, Eclipse can work with other programming languages (Ada, ABAP, C, C++, C#, Python, PHP, etc.) via plug-ins. A separate package — Eclipse IDE for Automotive Software Developers — contains tools and frameworks for quick and easy creation of embedded automotive software.

2- NetBeans

A free and open-source IDE for Java 8 development, NetBeans is supported by a large community of developers and users. It also encompasses PHP and C/C++ tools and allows for creating apps with CSS, JavaScript and HTML.

3- Visual Studio

A popular integrated development environment by Microsoft — Visual Studio — is used to build not only computer programs and mobile apps, but embedded software as well. The extension Visual C++ for IoT development enables programmers to debug native C/C++ code either locally on Windows, or on microcontrollers, or on remote Linux machines. Using Visual Studio for IoT, you can build, edit and debug devices running on Linux. Visual GDB provides an interface between Visual Studio and the GNU toolchain to build and debug embedded firmware. Thus, you can configure your project by implementing third-party compilers and tools.

4- Arduino

The open-source IDE Arduino helps create programs for Arduino microcontrollers. It provides a range of features and libraries that make the life of embedded programmers easier.

So according to the above comparison, we used Eclipse.

3.5 Atmega 32 Design

1. Software development for ATmega32: To receive data from the Bluetooth Application and convert the real time analog signal to digital signals and transmits these digital signals to a computer via serial communication "UART".

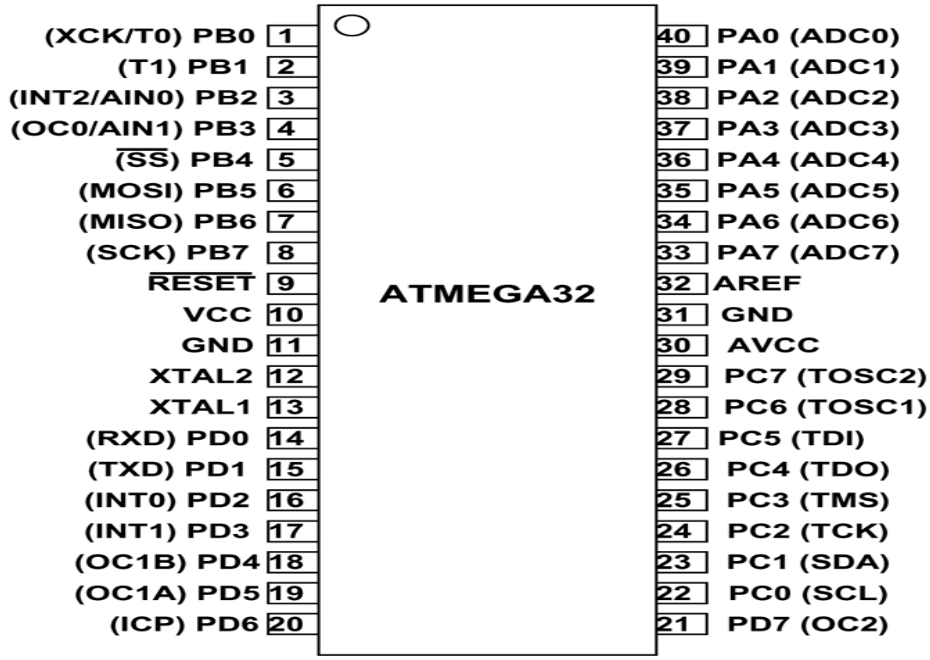

Fig3.2 about Pins

2. Check if the input is true for example that the arm will search about "headache medicine".
3. Move Arm to first position and check if the headache medicine is found!. If yes then catch but if false move to the second position and check again
4. Repeat this sequence till you find the object
5. If there is no object, take the data from Bluetooth Application again.

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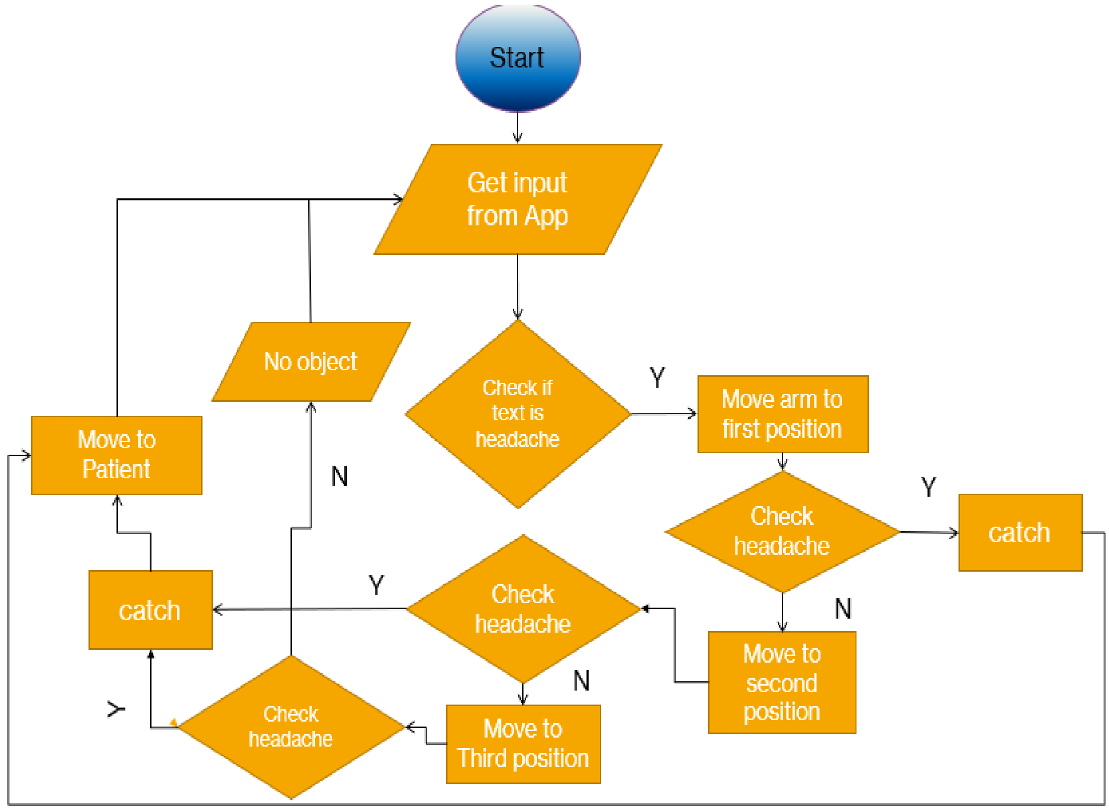

Flow Chart of the project

3.6 Raspberry pi :

- **Raspberry Pi 3** is tiny single board computer, introduced by Raspberry Pi Foundation, that comes with CPU, GPU, USB ports and i/o pins and capable of doing some simple functions like regular computer.
- This tiny computer was developed with the purpose of making computer learning process easy so an average student can get benefit and anticipate what an advanced computer can do.
- Raspberry Pi 1(first generation Model B) came into play in 2012, and soon got a renowned reputation in terms of ease of use and availability. Similarly, Raspberry Pi 2 was introduced in Feb,2015 will little improvement in design with added RAM than its previous version.
- Introduced in 2016, **Raspberry Pi 3 Model B** comes with a quad core processor that shows robust performance which is 10 times more than Raspberry Pi 1. And speed exhibits by Raspberry Pi 3 is 80% more than Raspberry Pi 2.

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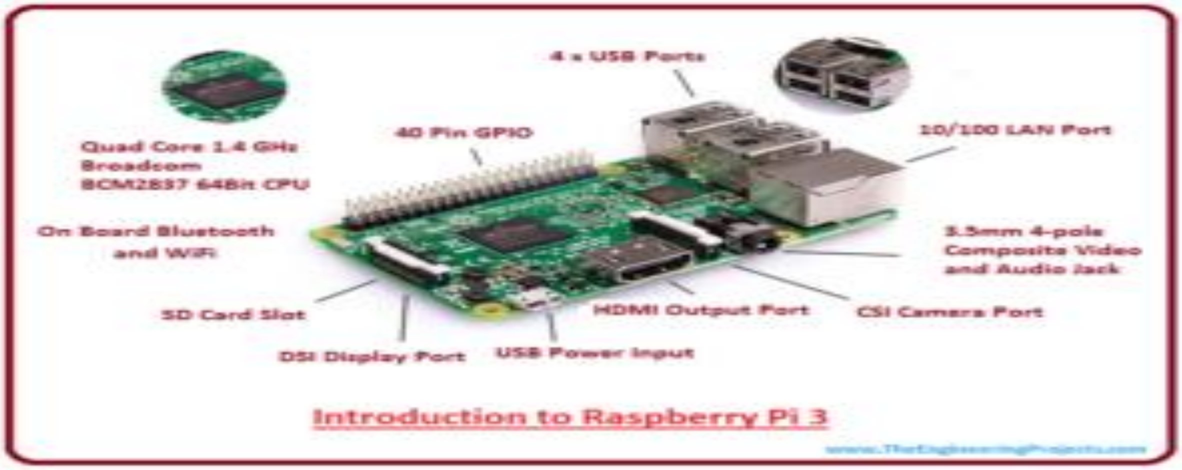

Fig 3.3 about Raspberry pi KIT

- The Raspberry hardware has gone through a number of variations in terms of peripheral device support and memory capacity. Every new addition comes with a little improvement in terms of design where advance features are added in the device so it can do as many function as possible like a regular computer.
- WiFi and Bluetooth that lack in older versions(Pi 1 and Pi 2), are added in the new addition of this device(Pi 3), allowing to maintain the connection with the peripherals without the involvement of any physical connection.
- Raspberry Pi Foundation recently launched **Raspberry Pi 3 Model B+** on 14 March 2018, which is the most recent version of Raspberry Pi 3 that exhibits all the specifications introduced in Pi 3 Model B, with the additional improvement including Network boot, USB boot, and Power over Ethernet which make the device useful in hard to reach places.

3.6.1 Raspberry Pi 3 Pinout:

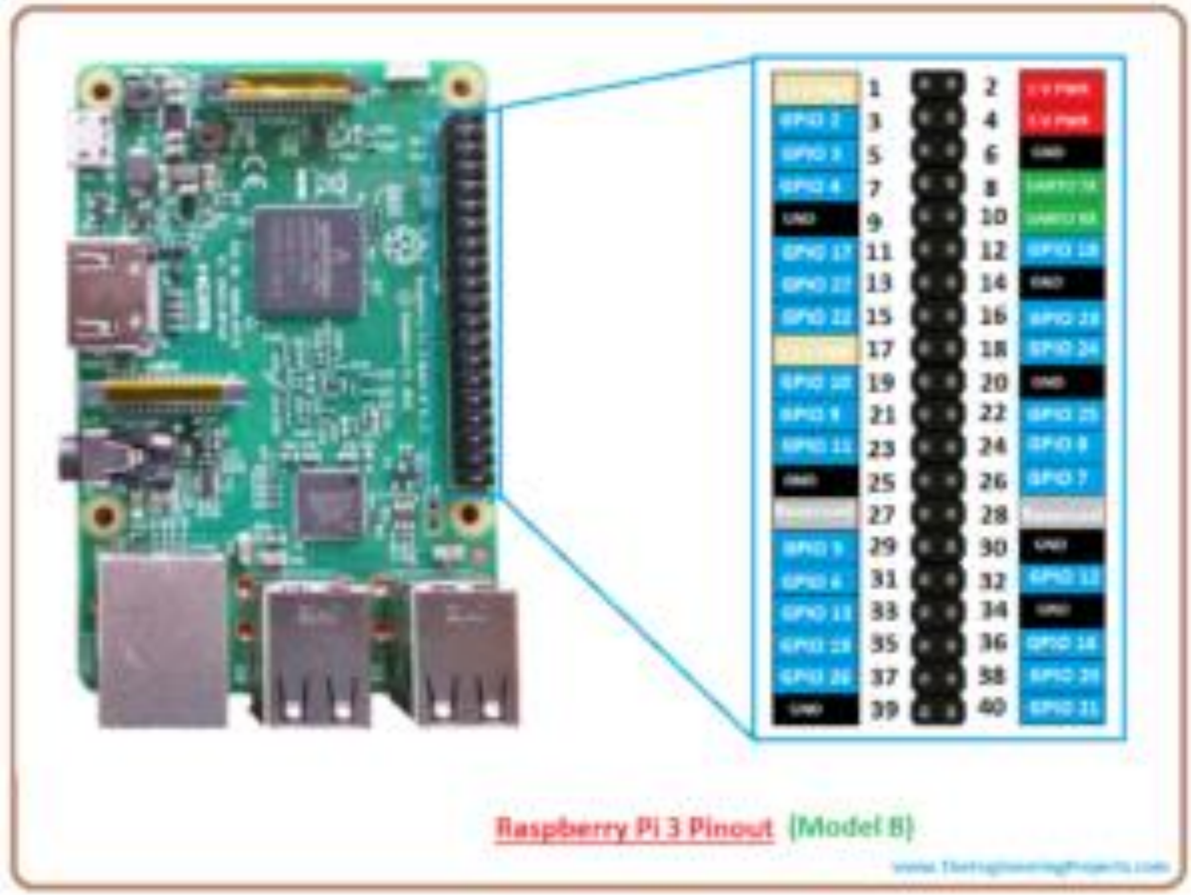

Fig 3.4 about Pins

- These are the 40 GPIO pins that are used for connection with other devices.
- You can see from the figure above, the UART pins are the serial input output pins that are used for serial communication for data and for the conversion of debugging code.

3.6.2 Hardware Specifications:

- Raspberry Pi 3 Model B comes with **64 bit quad core processor**, on board WiFi and Bluetooth and USB features.
- It has a processing speed ranging from 700 MHz to 1.4 GHz where RAM memory ranges from 256 to 1GB.
- The **CPU** of this device is considered as the brain of the device which is responsible for executing numbers of instructions based on mathematical and logical operation.
- The **GPU** is another advanced chip incorporated in the board that carries out function of image calculation. The board is equipped with Broadcam video core cable that is mainly used for playing video games through the device.

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- The Pi 3 comes with **GPIO** (General Purpose Input Output) pins that are essential to maintain connection with other electronic devices. These input output pins receive commands and work based on the programming of the device.
- The **Ethernet port** is incorporated on this device that sets a pathway for communicating with other devices. You can connect Ethernet port to the router to maintain a connection for internet.
- The Board has four **USB ports** that are used for communication and **SD card** is added for storing the operating system.
- **Power source connector** is a basic part of the board that is used to provide 5 V power to the board. You can use any source to set up a power for the board, however, it is preferred you connect power cable through laptop USB port for providing 5 V.
- The Pi 3 supports two connection options including **HDMI** and **composite**. The HDMI connector is used to connect LCD or TV, that can support 1.3 and 1.4 version cables. Composite video connection is used to connect the older version of TV with the device that uses the 3.5mm jack socket for the audio production.
- The new device comes with a video core multimedia **3D graphics** which is capable of playing 1080 MP video. This feature puts this advice ahead of its predecessors where video quality was not that much upgraded.
- The **USB hard drive** incorporated on the board is used to boot the device, similar to PC hard drive where windows is used to boot the computer hard drive.

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Fig3.5 about Specification

3.6.3 Browser Used

- Recent addition of Raspberry Pi comes with a Chromium browser which is quick and robust than the browser available in its predecessors, but still it gets stuck when it comes to opening number of heavy duty sites, however, YouTube video buffering is too quick that you don't need to wait too long before video comes into play.
- Opening number of sites at once can take more time than you anticipate, which ultimately hangs the device, causing the device memory to freeze or stuck.

3.6.4 Operating System

- The official Raspbian Linux operating system runs on Pi 3. Other third party OS that can operate on this device are RISC, Kodi Media Center, Windows 10 loT core, Ubuntu Mate and classroom management.
- There are other non-Linux based systems that can run on this device which you can pick based on your needs and requirements.
- Windows 10, the latest version of windows, can run remarkably well on the desktop computer, but running windows 10 on the Pi 3 is a whole new experience, not as good as

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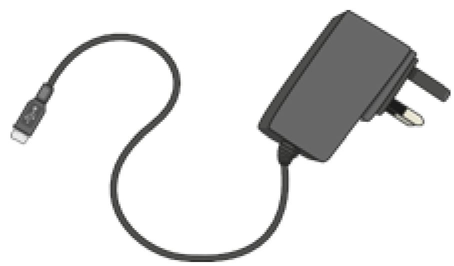
desktop computer, but still you can get a little glimpse of running windows 10 on a tiny device like Pi 3.

- The windows 10 that run on this device is not a full version of windows 10, but a reduced version that is called windows 10 loT core, capable of running only one single full screen windows app at a time, however, still it supports number of software running on the background.
- Running windows 10 on Pi 3 is not a good option though, it can make use of more processing power than required for other operating system.
- Raspberry Pi 3 is a 64 bit device, which is capable of running official Raspbian operating system. The Raspbian Pi Foundation is also looking to modifying the Raspbian operating system to make it compatible for 32 bit devices that were introduced a while ago.

3.6.5 Getting started with your Raspberry Pi.

If you don't have the Raspberry Pi Starter Kit, then in addition to the Raspberry Pi 3 Model B+ you'll need:

1- **USB power supply** – A power supply rated at 2.5 amps (2.5A) or 12.5 watts (12.5W) and with a micro USB connector. The Official Raspberry Pi Power Supply is the recommended choice, as it can cope with the quickly switching power demands of the Raspberry Pi.



2- **microSD card with NOOBS** – The microSD card acts as the Raspberry Pi's permanent storage; all the files you create and software you install, along with the operating system itself, are stored on the microSD card. An 8GB card will get you started, though a 16GB card offers more room to grow. Using a card with NOOBS, the New Out-Of-Box Software, pre-installed will save you some time; otherwise see **Part A** for instructions on installing NOOBS on a blank microSD card.

3- **USB keyboard and mouse** – The keyboard and mouse allow you to control the Raspberry Pi. Almost any wired or wireless keyboard and mouse with a USB connector will work with the Raspberry Pi, though some 'gaming' style keyboards with colourful lights may draw too

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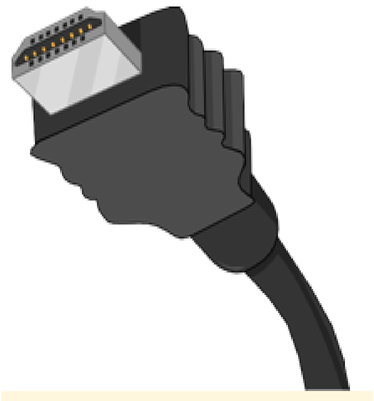
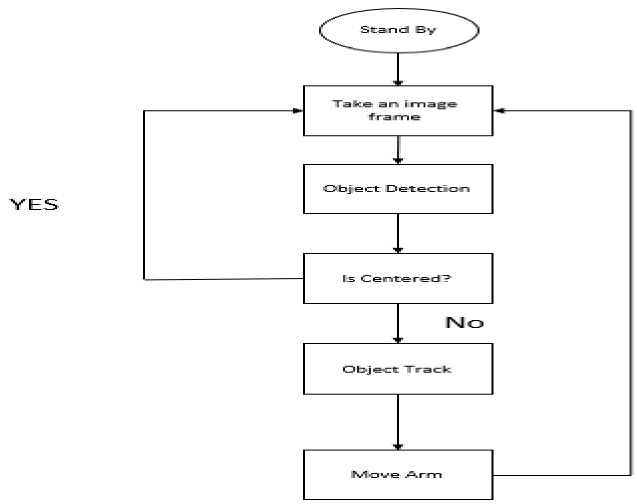
much power to be used reliably.

4- **HDMI Cable** – The HDMI cable carries sound and pictures from the Raspberry Pi to your TV or monitor. There's no need to spend a lot of money on an HDMI cable. If you are using a computer monitor without an HDMI socket, you can buy HDMI to DVI-D, DisplayPort, or VGA adapters; if you want to connect your Raspberry Pi to an older TV which uses composite video or has a SCART socket, use a 3.5 mm tip-ring-ring-sleeve (TRRS) audio/video cable.



3.7 Raspberry pi Project Steps:

1- Camera takes frame That frame divided into alot of pixels according to quality of camera which calculated by pixometer.
2- Each pixel has value according to color it present.
3- The whole frame value compared to critical value of color then take decision.



Block diagram about RGB detection

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Appendix

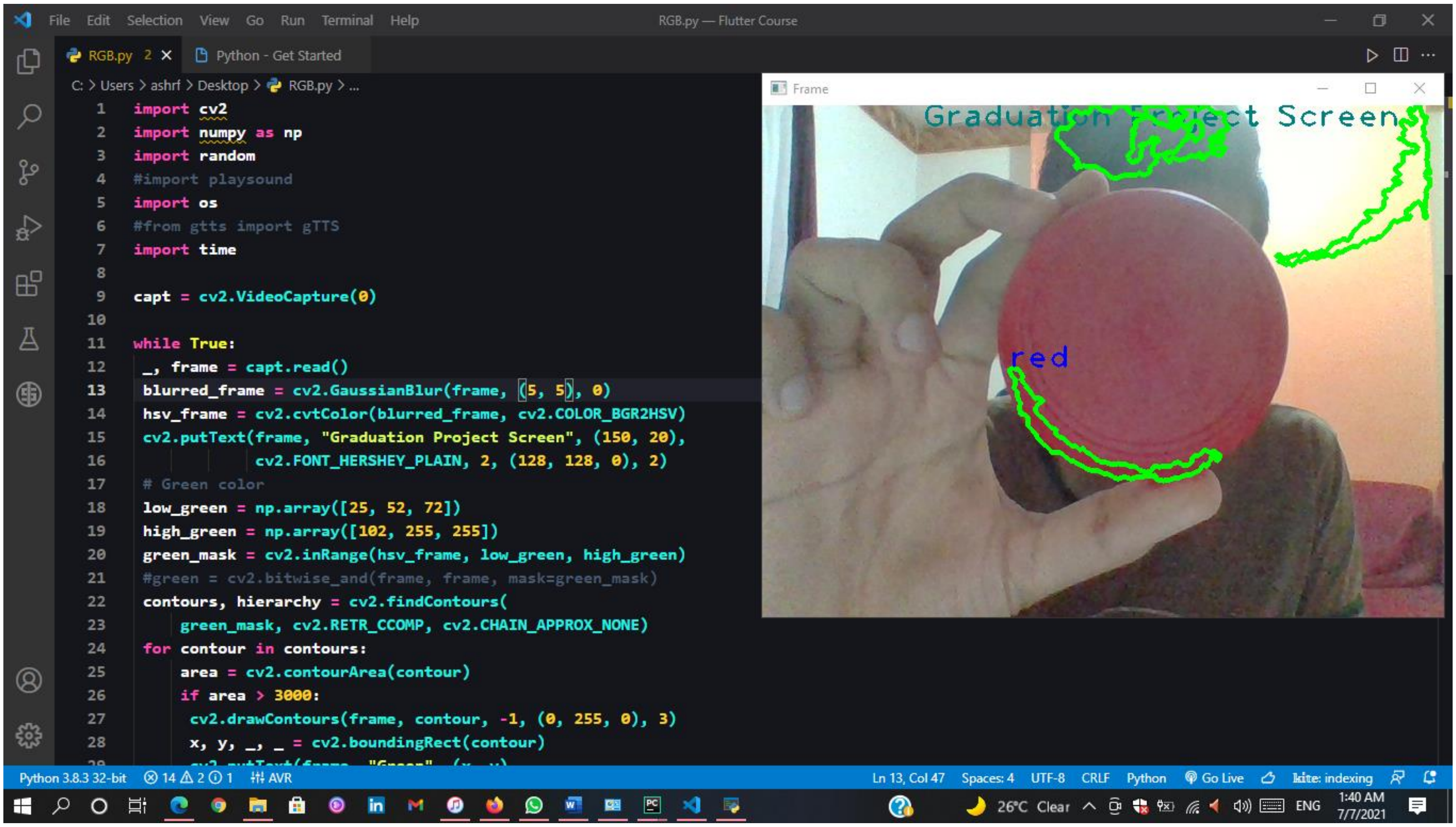

Fig 3.6: Red Color Detection

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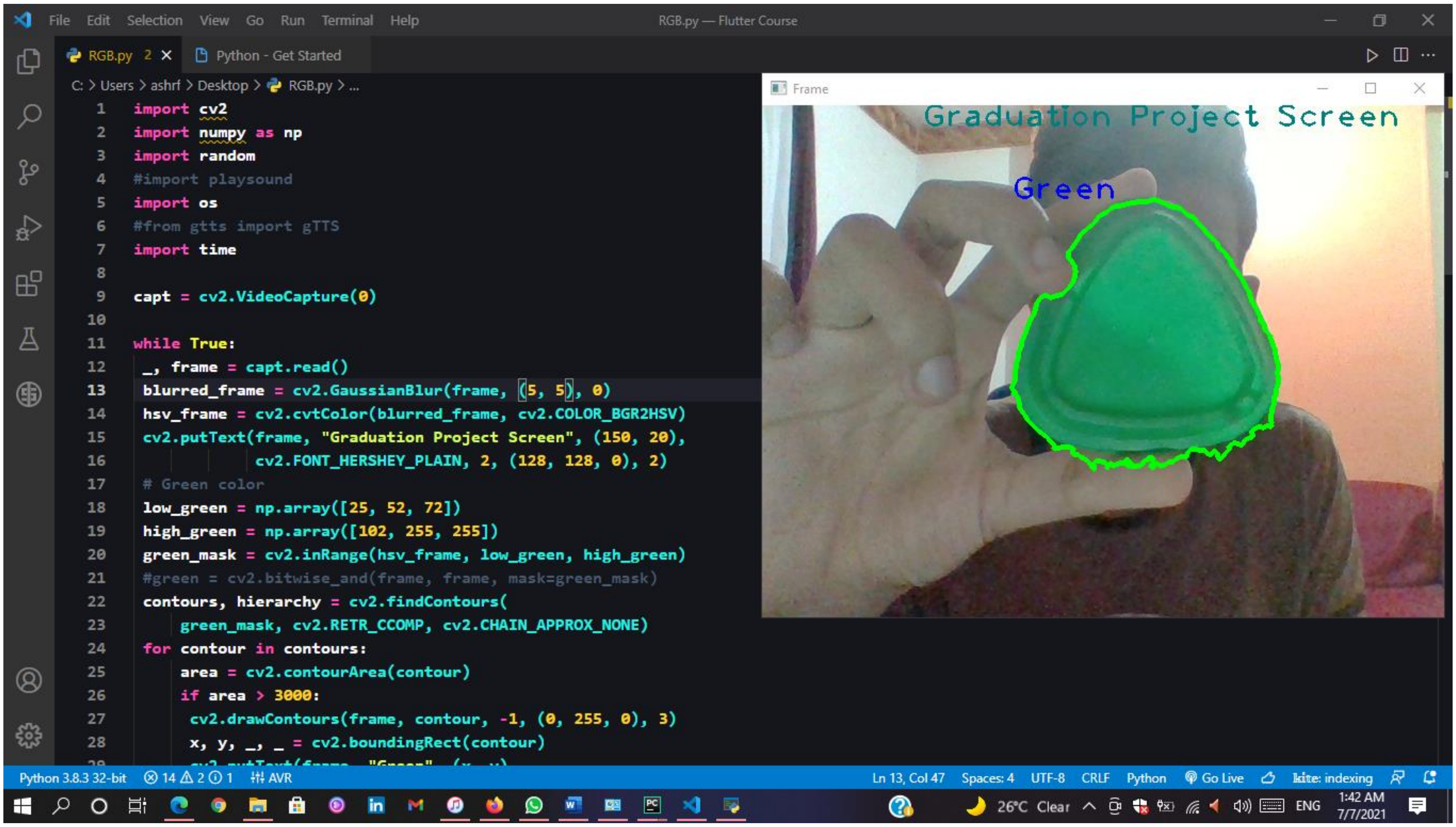

Fig 3.7: Green Color Detection

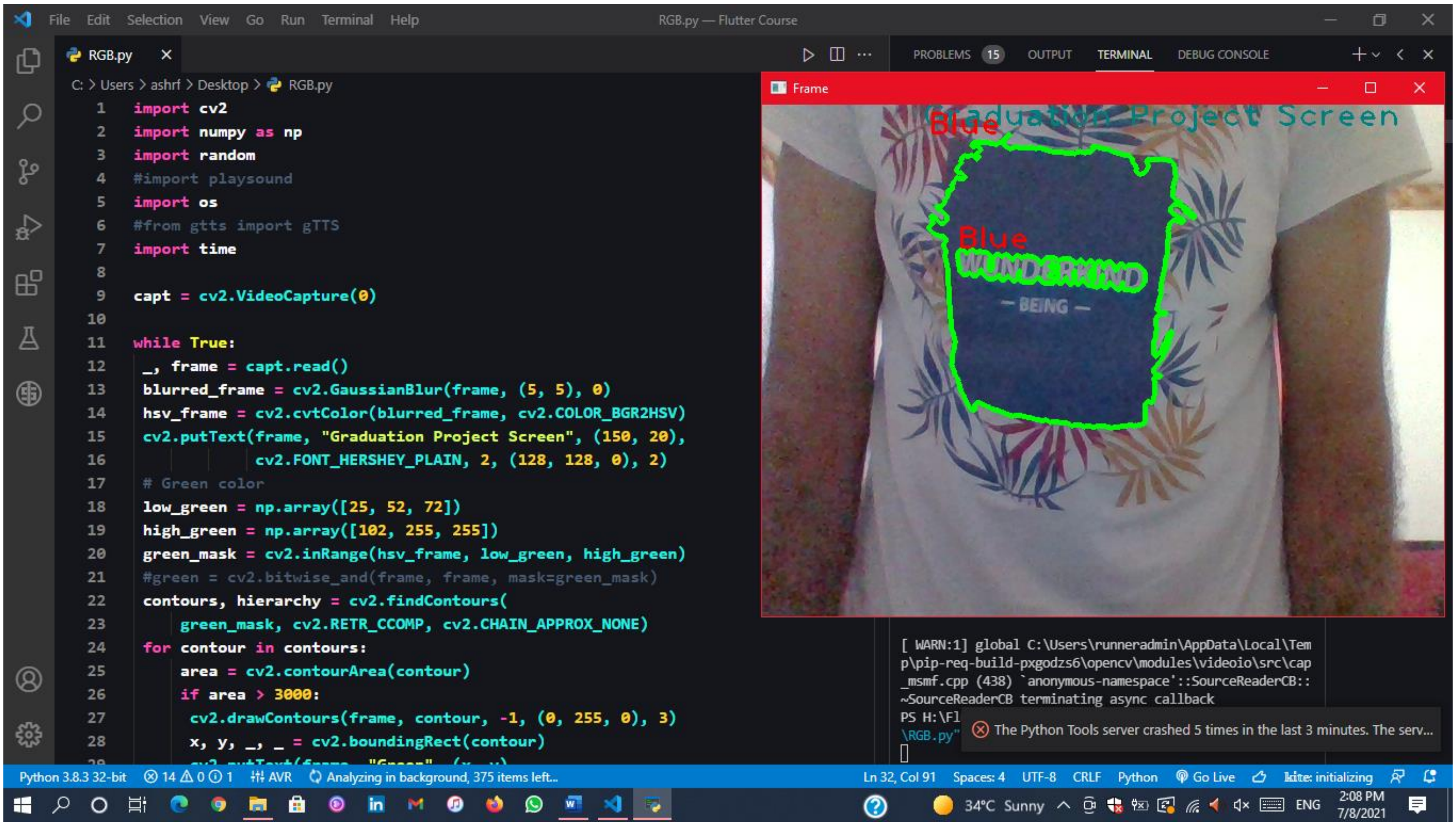

Fig 3.8 : blue color Detection

3.8 HC-05 Bluetooth Module:

HC-05 Bluetooth Moduleis an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.Itscommunicationis via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave modewhich means it able to use neither receiving nor transmitting data.

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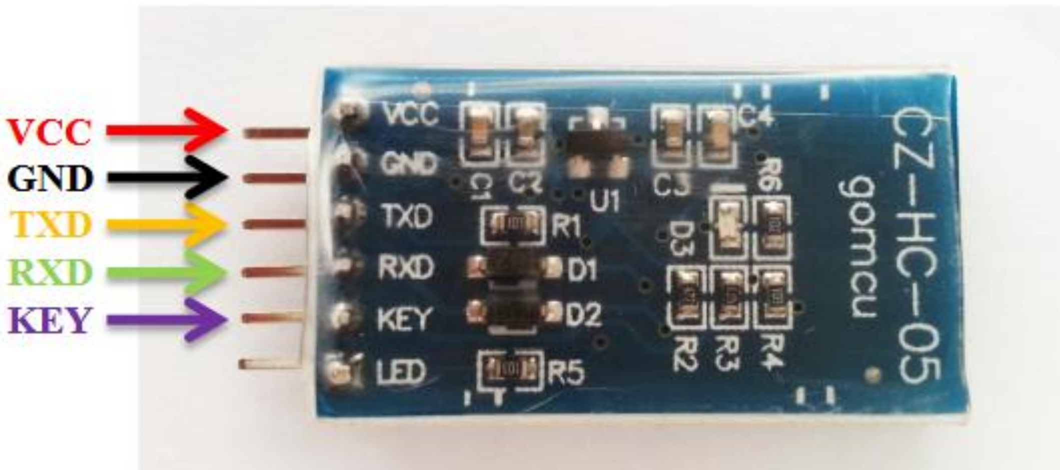
Specification:

•Model: HC-05

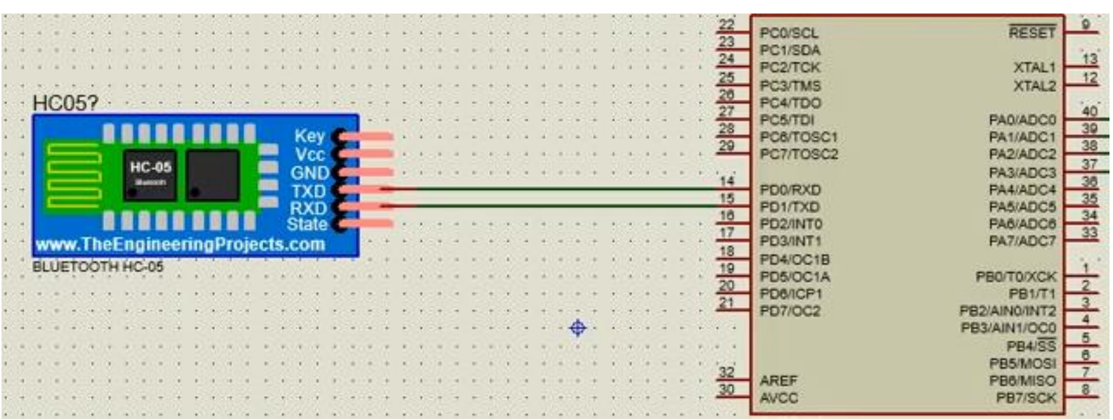
•Input Voltage: DC 5V

•Communication Method: Serial Communication

•Master and slave mode can be switched



3.9 Fig. Pin Definition



3.10 Fig. Interfacing HC-05 with ATMEGA32

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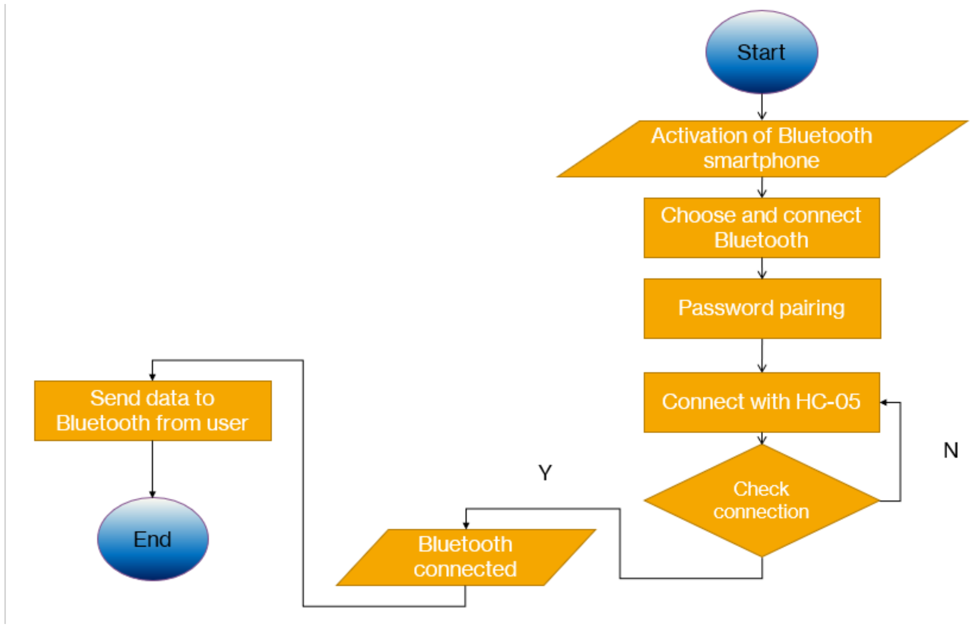

Flow chart about Connecting HC-05

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3.9 Reason of using Servo Motor

3.9.1The Purpose of Servo Motors

Technology has come a long way since the invention of the wheel in 3,500 B.C. Technological advancements have allowed humans to live and work more conveniently and more efficiently. With hundreds of thousands of technological breakthroughs throughout history, some of the most important everyday technologies have gotten lost in the shuffle and people have become unaware of their importance over time.

Unbeknownst to most people, parts such as servo motors play a huge role in making people's lives easier every day. Small technological pieces such as servo motors are heavily used daily in devices you least expect, as you'll learn with the continuation of this article. It is also used in the industrial field including various of Fuji Electric's products.

Learn everything you need to know about servo motors - including its purpose, the list of everyday items and machines that operate using it, its advantages and disadvantages, and its parts and their functions.

Fig 3.11 about the shape of the arm in factories

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Servo motors or “servos”, as they are known, are electronic devices and rotary or linear actuators that rotate and push parts of a machine with precision. Servos are mainly used on angular or linear position and for specific velocity, and acceleration.

Companies heavily use servo motors because of how compact and potent it is. Despite its size, it generates quite the amount of power and is known to be incredibly energy-efficient.

Most of the companies that use servos are manufacturing companies that need it to position control surfaces and rotate objects at precise angles and distances. Most of the companies that use servo motors are manufacturing companies that use machines with servo motors.

3.9.2 Two Types of Servo Motors:

There are two types of servo motors that are available and used in the industrial field.

First is the AC servo motor. This type of servo is currently used today by most companies. AC servo motors are mostly used in industrial fields. AC servo motors are AC motors that rely on encoders. These types of servo motors work through controllers providing feedback and closed-loop control. They are known to function at a high accuracy and are easily controllable.

Second is the DC servo motor. These kind of servo motors were used in the past by Fuji Electric but are rarely used nowadays, as AC servo motors are easier to use, more effective, advanced, and reliable.

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Fig 3.12 items use servo motors

Servo motors are utilized by items that are used every day. Home electronic devices like DVD and Blu-ray Disc players use servos to extract and retract disc trays.

Automobiles also use servo motors. In modern cars, servo motors are used to control its speed. When stepping on the gas pedal, it sends electrical signals to the car's computer. The computer then processes that information and sends a signal to the servo attached to the throttle to adjust the engine speed. Even commercial aircrafts also make use of servos to push and pull everything within the plane.

They are also used for novelty items such as remote-controlled and scale-sized toy cars, toy airplanes, toy helicopters, and toy robots. Servos are especially helpful for radio-controlled airplanes to position control surfaces.

But servos are mostly used for industrial purposes. Important industries such as robotics, pharmaceutics, food services and in-line manufacturing also make use of servos.

Servos are also most-suited for electrically operated pieces of machinery such as elevators, rudders, walking robots, and operating grippers.

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3.9.3 Advantages and Disadvantages

Servo motors provide quite a lot of advantages but as with all things, they also pose some problems and difficulties for companies who utilize this device.

Advantages

Servos are known to always be frequent and work at the same pace. So, if a heavy load is placed on the motor, the driver will increase the current to the motor coil as it rotates the motor. This basically means that servo motors are expected to always be mechanically on point. And because of its precision, it allows companies to operate it at a high-speed pace.

Disadvantages

As with anything that provides convenience and efficiency, servo motors also tend to have a high cost when it comes to maintenance and operation. Moreover, when a machine using a servo is stopped, the motor continues to move back and forth one pulse, so it is not good if the machine or area is not suitable with vibrations.

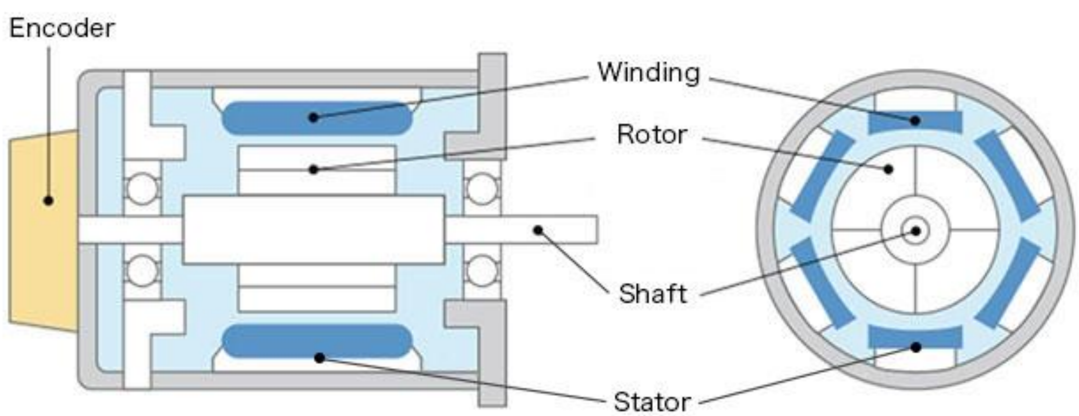

Fig 3.13 about servo motors parts and functions

Dozens of parts make up a servo motor with each and every single part playing a vital role in the device's functionality. Here are its most important parts and the significant roles they play in the functionality of the servos.

- Stator - A stator creates a rotating magnetic field to efficiently generate torque.
- Winding - Current flows in the winding produces a rotating magnetic field.
- Shaft - The shaft transmits the motor output power. This load is driven through the transfer mechanism.

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- Rotor - A rotor is a permanent magnet that is positioned externally to the shaft.
- Encoder - An optical encoder always observes and calculates the number of rotations being completed and watches the position of the shaft.

Each part of the servo motor serves a huge purpose in making the servos properly function or work.

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Chapter four

Mobile Application

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4.1 Introduction

In this chapter we will explain mobile application and the Bluetooth Module
(HC-05)
mobile application development:

Mobile application development is the process to making software for smartphones and digital assistants, most commonly for Android and iOS. The software can be preinstalled on the device, downloaded from a mobile app store or accessed through a mobile web browser. The programming and markup languages used for this kind of software development include Java, Swift, C# and HTML5.

Mobile app development is rapidly growing. From retail, telecommunications and e-commerce to insurance, healthcare and government, organizations across industries must meet user expectations for real-time, convenient ways to conduct transactions and access information. Today, mobile devices—and the mobile applications that unlock their value—are the most popular way for people and businesses to connect to the internet. To stay relevant, responsive and successful, organizations need to develop the mobile applications that their customers, partners and employees demand.

Yet mobile application development might seem daunting. Once you've selected the OS platform or platforms, you need to overcome the limitations of mobile devices and usher your app all the way past the potential hurdles of distribution. Fortunately, by following a few basic guidelines and best practices, you can streamline your application development journey.

To learn more about the specifics of mobile application development on either platform, read our articles on iOS app development and Android app development.

4.2 Choose a Platform:

Many independent application development teams choose to build their apps for Android first. Why? The vast majority—around 70 percent—of smartphones run Android, and the Google Play Store has fewer restrictions than the Apple App Store. On the other hand, mobile applications developed for iOS have far fewer devices that need support, making optimization simpler. And user retention is typically higher for IOS applications. Depending on the intended use case and target audience for the mobile application you are developing, you might have other considerations. For example, if you're designing an app for your organization's employees, you'll need to support the platforms they use, which may mean developing cross-platform apps that work for both Android and iOS. Or if you're building a mobile application for your customers and you know the majority of them use iPhones, then developing iOS applications should be a top priority. Additional considerations when developing your mobile applications include monetization strategies and anticipated user behavior, which can be influenced by geographical and cultural factors.

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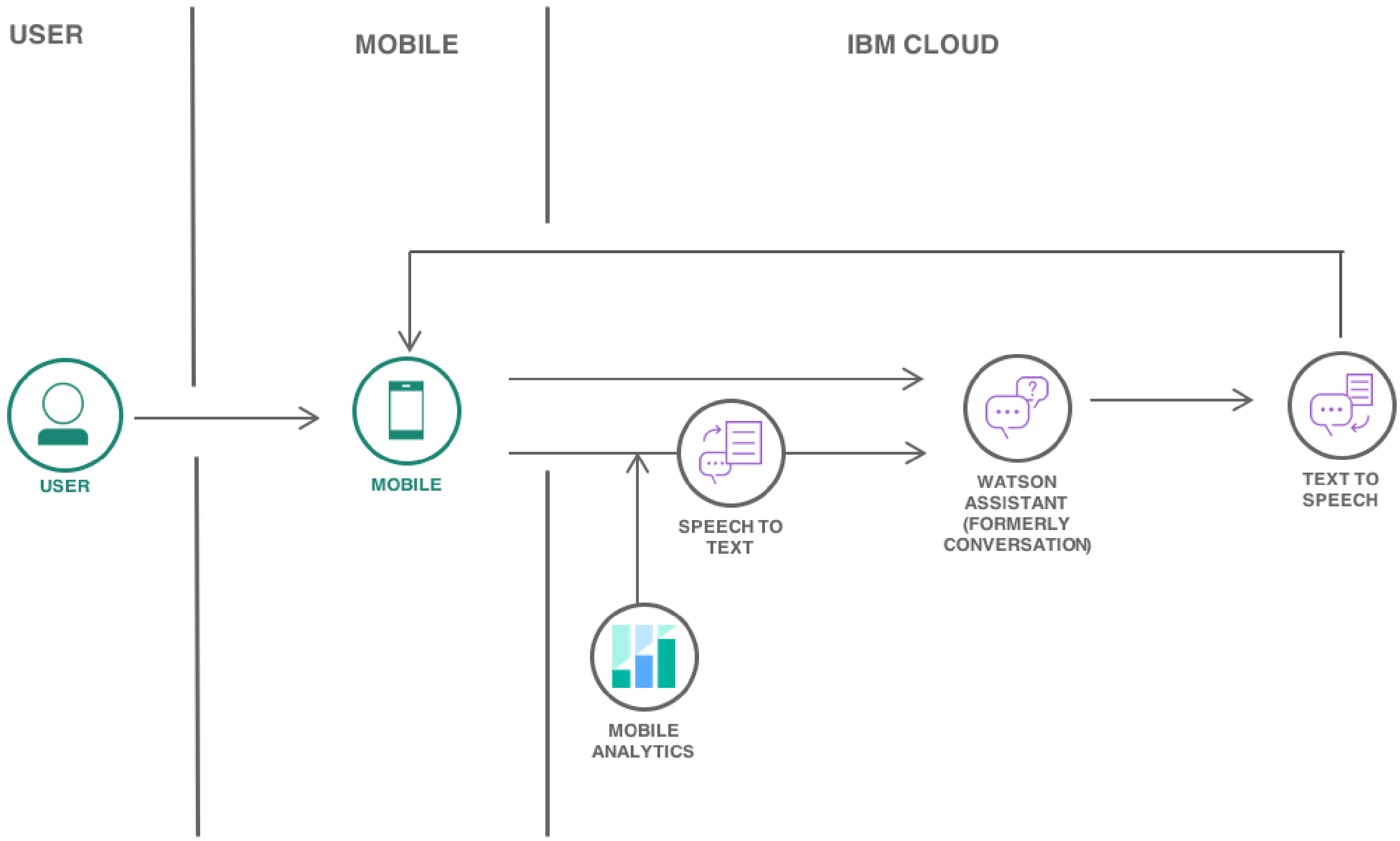

Fig 4.1 Enhance efficiency and tighten security by integrating the development platform and device management tool

Comparison Between Tools for Android Software Development

Android development is in its heyday. According to Statista, there are 2.9 billion apps available in Google Play. As the use of Android devices goes up, the need for high-quality Android apps continues to grow. These days, Android developers need to stay productive to create better quality apps at record speed. To that end, they have a wealth of useful tools and applications at hand. In this article, we are going to have a look at what's inside a developer's toolbox and Android development kit. So here's the list of the best Android development tools.

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Fig 4.2 of Android Logo

1- Android Studio: Key Android Build Tool

Android Studio is, without a doubt, the first one among Android developers' tools. It's an official integrated environment for Android app development that lets easily edit code, debug, and test.

Created in 2013, it made a splash and unseated Eclipse Android Development Tools as the one and only IDE for native Android apps. It's free and actively supported by a vibrant Android development community.

2- AIDE

It's an Android IDE that allows making an Android app on your Android device. AIDE provides a way not only to write the code on your phone or tablet but also to run, test, and debug. This environment is a good option for novice developers as opposed to Android Studio or IntelliJ IDEA. The downside is that it only supports Java and C/C++. If you are building an app in Kotlin, go with another Android IDE.

3- Stetho

Stetho is an open-source library developed by Facebook and designed for quick application debugging. Stetho gives the application a website experience by making the allows access to a Chrome Developer Tools feature native to the desktop browser.

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With the Chrome DevTools, you can easily view the hierarchy of an application, monitor network activity, manage an SQLite database, monitor shared SharedPreferences, and more.

4- Gradle

Gradle is an open-source build automation system that appeared in 2013. Combining the best of Apache Maven and Apache Ant, this system is ideal for multi-project, large builds. Gradle makes it easy to add a third-party library with one line of code. Gradle is mainly used for Android software development using Java, but there are also Groovy and Scala plugins.

So according to the above Comparison we selected the Android Studio.

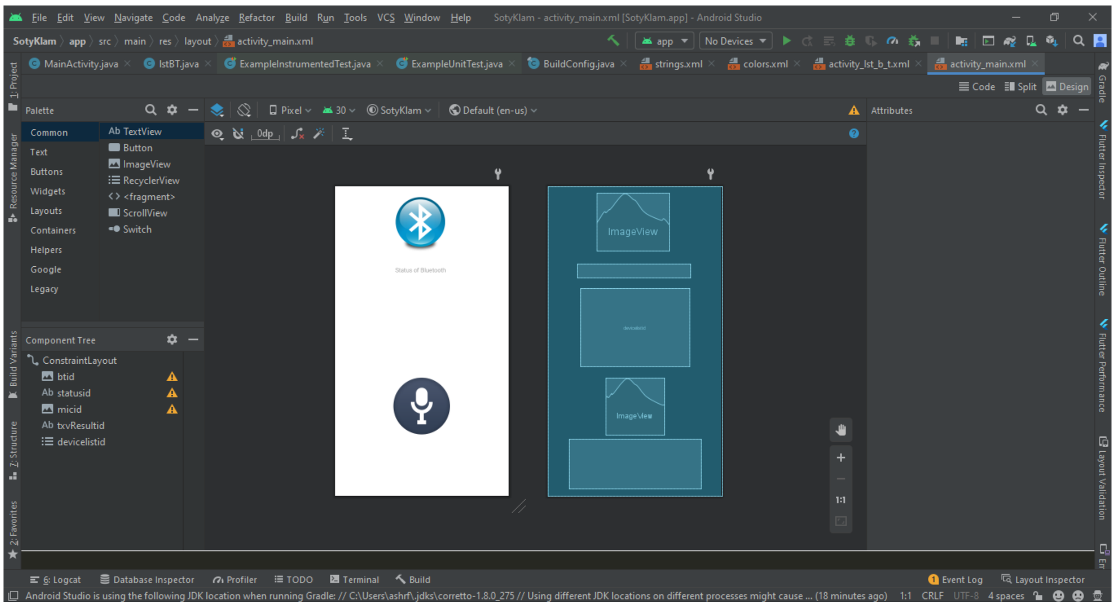
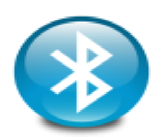


Fig4.3 . Design of Mobile Application

Steps of developing mobile application:



1- Put Bluetooth button (ON/OFF).

2- Put MIC button.

3- Define the above buttons by ID of each of them.

4- connect these buttons to Bluetooth Adapter Function.

5- Pair the phone cellular and check if it is connected correctly.

6- create input speech function to get the voice and sends it to HC-05.

7- after receiving the command, then the arm will recognize the ordered command to verify it's color using Raspberry py so we will explain more about Raspberry in next.

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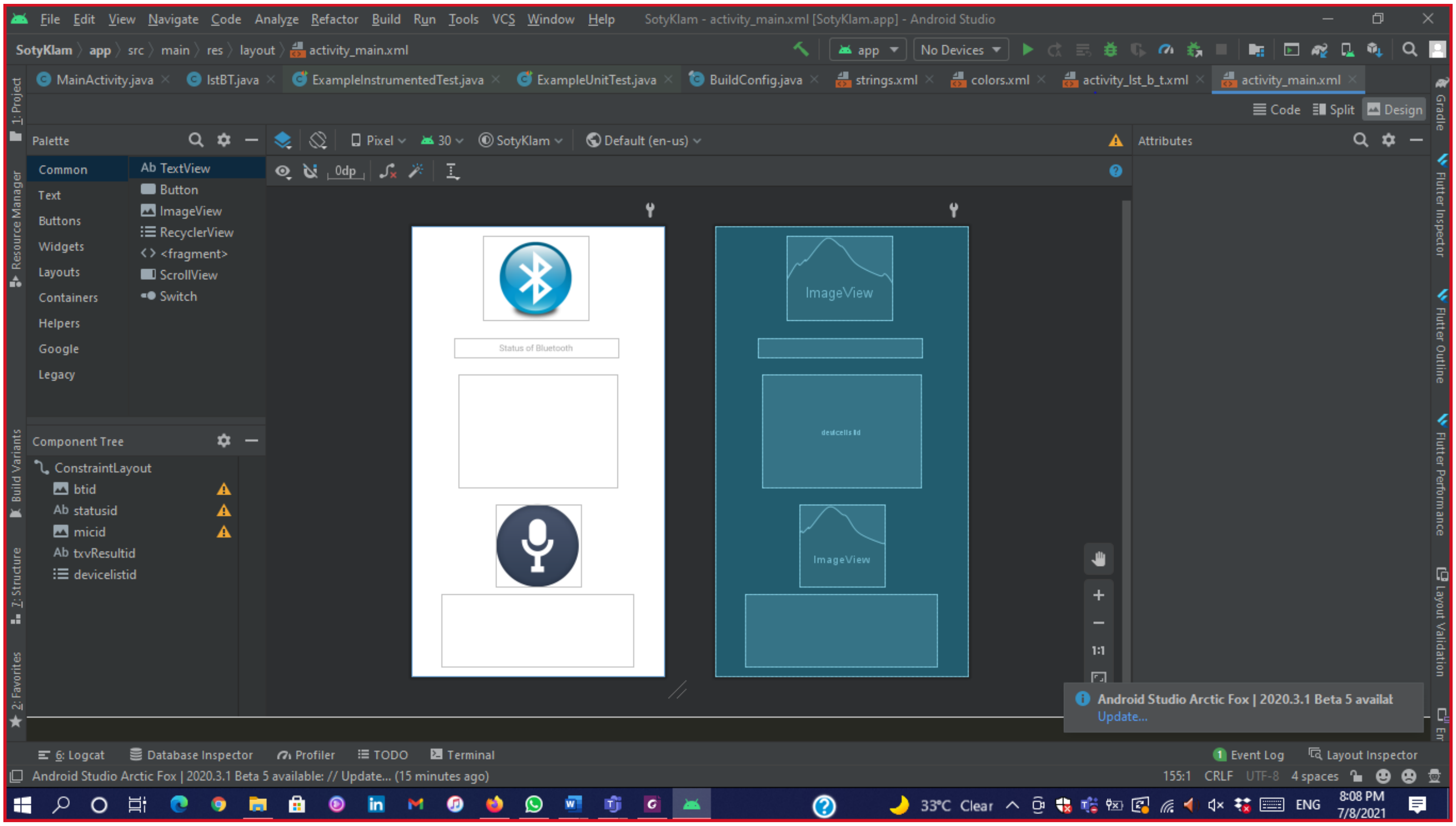
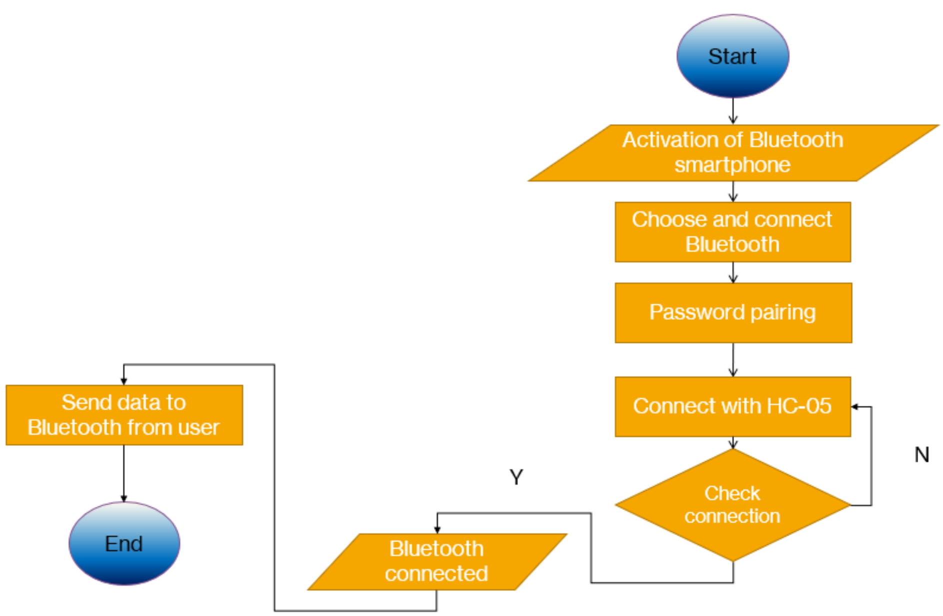


Fig4.4 . it is our mobile application design



flow chart about how to connect HC-05 to smartphone

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4.3 HC05 Bluetooth Module Interfacing with AVR Atmega 32

HC-05 is a Bluetooth device used for wireless communication. It works on serial communication (USART). It is a 6 pin module. The device can be used in 2 modes; data mode and command mode. The data mode is used for data transfer between devices whereas command mode is used for changing the settings of the Bluetooth module. AT commands are required in command mode. The module works on 5V or 3.3V. It has an onboard 5V to 3.3V regulator. As the HC-05 Bluetooth module has a 3.3 V level for RX/TX and the microcontroller can detect 3.3 V level, so, no need to shift the transmit level of the HC-05 module. But we need to shift the transmit voltage level from the microcontroller to RX of the HC-05 module. For more information about the HC-05 Bluetooth module and how to use it, refer to the topic Bluetooth module HC-05 in the sensors and modules section. For information on USART in AVR ATmega16/ATmega32 and how to use it, refer the topic on USART in AVR ATmega16/ATmega32 in the ATmega inside section.

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Chapter 5
Conclusion
&
Future Plans

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5.1 Conclusion

I hope that you enjoyed this robotic arm unit. Not only did you apply math and science to your project, but you also learned the importance of shop safety and working together with your team mates. Each team mate had a job to do. Engineers were in charges of the final design and oversight of building your robot arm. Accountants were in charge of your business expenses. Finally Project Directors were in charge of your teams' public affairs and overall completion of your project. Hopefully you were able to see how there is more to just having the best design. Working together as a team is just as important in accomplishing the different challenges you may face in your life. I hope that you will be able to apply the methods and ideas from this project in your day to day lives.

The results of the works presented show that with current technological resources it is possible to develop many types of aids that can be adapted for people with different degrees of impairments. But, there is still important problems to be solved such as: power storage, that limits autonomy and forces to re-charge batteries; the miniaturization of devices, since their external aspect conditions their acceptance; and the development of more intelligent interfaces to simplify still more the use of these equipment by persons not ready to use automated equipment, and that frequently have not only motor disabilities but also visual impairment. Cost is also a decisive factor in the acceptance of these products. The major diffusion of this technology and products and the important and increasing market for them will presumably produce a reduction of costs in the next years.

5.2 Future Plans:

We will talk in this Part about our aims to the project which did not achieved due to some limitations.

Such as:

1- Time of Work

2- Availability of Components

3- Components Cost

We will complete the raspberry pi process by doing full Image processing Project to detect full object instead of detecting RGB Objects. And we will make the Robotic Arm help the Patient in eating and drinking.

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5.2.1 Image Processing:

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

In this lecture we will talk about a few fundamental definitions such as image, digital image, and digital image processing. Different sources of digital images will be discussed and examples for each source will be provided. The continuum from image processing to computer vision will be covered in this lecture. Finally we will talk about image acquisition and different types of image sensors.

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5.3 References

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