CELL PHONE CONTROLLED ROBOTIC ARM WITH MOVING VEHICLE

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ABSTRACT

The work is designed to develop a pick and place robotic arm vehicle with a soft catching gripper that is designed to avoid extra pressure on the suspected object (Like Bombs) for safety reasons. The robotic vehicle is android application controlled for remote operation. At the transmitting end using android application device, commands are sent to the receiver to control the movement of the robot either to move forward, backward and left or right etc. At the receiving end four motors are interfaced to the microcontroller where two of them are used for arm and gripper movement of the robot while the other two are for the body movement of the vehicle. The main advantage of this robot is its soft catching arm that is designed to avoid extra pressure on the suspected object for safety reasons. The android application device transmitter acts as a remote control that has the advantage of adequate range, while the receiver end Bluetooth device is connected to the microcontroller to drive DC motors via motor driver IC for necessary operation. Remote operation is achieved by any smart-phone/Tablet etc., with Android OS; upon a GUI (Graphical User Interface) based touch screen operation. The design analysis of a Remote Controlled "Pick and Place" Robotic vehicle has been presented in this paper. This work unravels the fact that man would always want to adhere to safety precautions at workplace and even in its environment, to be able to handle some specific tasks, like sending the robotic vehicle to hazardous environment to obtain samples for chemical analysis.

Keyword : - *Robotic Vehicle, Soft catching Arm, Joint Actuator, smart phone, Wi-Fi Module, Pick and Place.*

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1. INTRODUCTION

Robots are indispensable in many manufacturing industries. The reason is that the cost per hour to operate a robot is a fraction of the cost of the human labor needed to perform the same function. More than this, once programmed, robots repeatedly perform functions with a high accuracy that surpasses that of the most experienced human operator. Human operators are, however, far more versatile. Humans can switch job tasks easily. Robots are built and programmed to be job specific. Today's most advanced industrial robots will soon become dinosaurs. Robots are in the infancy stage of their evolution. As robots evolve, they will become more versatile, emulating the human capacity and ability to switch job tasks easily. While the personal computer has made an indelible mark on society, the personal robot hasn't made an appearance. Obviously there's more to a personal robot than a personal computer. Robots require a combination of elements to be effective: sophistication of intelligence, movement, mobility, navigation, and purpose. In the beginning, personal robots will focus on a singular function (job task) or purpose. Building a useful personal robot is very difficult. But recent days Robots occupies a good place in community. The main functioning of robotics in recent days are.

In this work, a miniature Remote Control Robotic Vehicle(RCRV) with Six degree of freedom (6 DOF) robotic arm has been designed and developed .The objective is to produce a basic model with four wheels, standard sensors and a robotic arm with the vehicle acting as a base for it mobility. It is also intended that the structure of the robot should be simple to facilitate easy adaptation and upgrading. The housing is designed to create three distinct layers within the RCRV to separate elements of the robot, thus leaving room to add more devices when completed. The bottom layer was designed for battery housing and mechanical hardware, such as wheels and gears, the middle layer to contain the main interface electronics, and the top layer for the arm and external device.[5]

Hazardous duty

Without risking human life or limb, robots can replace humans in some hazardous dutyservice (see Fig1). Take for example bomb disposal. Robots are used in many bombsquads across the nation. Typically these robots resemble small armoured tanks and areguided remotely by personnel using video cameras attachedto the front of the robot. Robotic arms can grab a suspected bomb and place it in anexplosion-proof safe box for detonation and/or disposal.Similar robots can help clean up toxic wastes. Robots can work in all types of pollutedenvironments, chemical as well as nuclear. They can work in environments so hazardousthat an unprotected human would quickly die. The nuclear industry was the first todevelop and use robotic arms for handling radioactive materials. Robotic arms allowedscientists to be located in clean, safe rooms operating controls for the robotic arms locatedin radioactive rooms.

Relevance

There are so many hazardous situations in day to day life. There are so many occasionswhere the human can't work .In that situations without a considerable amount of safetyprecautions like, the disposal of hazardous wastes, radioactive substances, remote handling of explosive devices and righting and hostage situations among others. It cansafely work at hazardous conditions. These robots ensures the human safety and replacemassive human work force.It can be also applied in medical science, surgeries, and defence purposes, with artificialintelligence, super market field, and manufacturing field. These are compact and efficientrobotic systems.

Fig. 1: Some first robot in the world. From left: Mars Path Finder, Sojourne , Rover.Hazbot.

The planet corporation in 1959 introduced a pick and place robot. In 1961, the first industrial robot was commercialized by Unimation Inc. Microprocessor technology was brought by INTEL in 1961. The real robot development process continued between 1968 and 1982 when various models of robots were developed by leading robot scientists in different universities, national laboratories and different industrial houses in the USA, Japan, France, UK, and other European countries.[4]

Some of the robot models of historical interest are the **Versatran** by AMF, developed in (1963) and **Cincinnati Milacron[1]** introduced in (1974), Irb-6 by ASLA in (1978). The **Kawasaki** and **Hitachi** groups in Japan have also contributed a lot in developing various sensors to make robots „think" intelligently. **John Iovine**, in this book various aspects of designing a Robot is described. It deals with different types of Arm design, controlling techniques, vehicle design etc… In the remaining references different types controlling technique are explained. The Idea about the Android software „Blue control" and its application in controlling Robotics is described in the Google play store website. From all these we find a different controlling technique using android device and software with a different approach for soft catching arm (electronic pressure sensor). **Amit** shelled, he is assistant professor of mechanical engineering in JSPM nahre technical campus in pune. He had published a journal for design and implementation pick and place robotic arm in the journal of IJRRCME (International journal of recent research in civil and mechanical engineering) vol. 2, issue 1, on apr-sep 2015. He state that the design of six axis pick and place robotic arm and how implement the axis and reach of robotic arm with cad modeling software.[1]

John Iovine [2], in this book various aspects of designing a Robot is described. It deals with different types of Arm design, controlling techniques, vehicle design etc. ER. Rajput, in this book the operation and control of robots is discussed. Arduino cookbook, in this book details and methods of interfacing hardware components such as DC motor, Servo motor and RF Transmitter and Receiver is been discussed. The other references listed in the references section discusses similar concepts in its various fields such as color identification and segregation robot, robot for surveillance, pick and place robot controlled using android etc.

1.1 LAW OF ROBOTICS:

Isaac Asimov conceived the mechanical arm as humanoids hand,devoid of feelings, and used them in a number of sto1ries.His mechanical arm were well designed ,fail-safe machines, whose brains were programmed by human beings.Anticipating the danger and have such device could cause , he postulated rules for their ethical conduct.Mechanical arm were required to perform according to three principles known as “Three laws of mechanical arm” which are as valid for real mechanical arm as they were for Asimov’s mechanical arm and they are:

1. A mechanical arm should not injure a human being or ,through inaction ,allow a human to be harmed.
2. A mechanical arm must obey orders given by humans except when that conflicts with the first law.
3. A mechanical arm must protect its own existence unless that conflicts with the First or Second Law.

These are very general laws and apply even to other machines and appliances.They are always taken care of in any mechanical arm design.

1.2 DEGREE OF FREEDOM:

The number of DOF that a manipulator possesses is the number of independent position variables that would have to be specified in order to locate all parts of the mechanism; it refers to the number of different ways in which a robot arm can move in the particular direction. In the case of typical industrial robots, because a manipulator is usually an open kinematic chain, and because each joint position is usually defined with a single variable , the number of joints equals the number of degree of freedom. We can use the arm to get the idea of degree of freedom. Keeping the arm straight ,moving it from shoulder ,We can move in three ways. UP and DOWN movement is called pitch. Movement to the right and left is called yaw. By rotating the whole arm as screwdriver is called roll. The shoulder has three degree of freedom. They are pitch ,yaw and roll. Moving the arm from the elbow only, holding the shoulder in same position constantly.The elbow joint has the equivalent of pitch in shoulder joint , thus the elbow has one degree of freedom. Now moving the wrist straight and motion less, we can bend the wrist and up and down ,side to side and it can also twist a little. The lower arm has the same three degrees of freedom. Thus the robot has totally seven degree of freedom. Three degree of freedom are sufficient to bring the end of a robot arm to any point within its workspace , or work envelope in three dimensions.

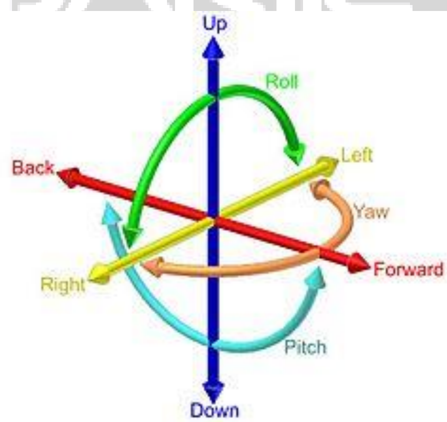

Fig. 2 : Degree of freedom

2. PROBEM DEFINATION

The robotic arm has six degrees of freedom. It's made of various links forming an open chain. The arrangement of these links depends on the adopted design. The arm has a rotating base that is resting on the upper region of the vehicle. The arm terminates with a gripper or a specialized tool holder; it has six degrees of freedom. The first three links of the arm form the body and which helps to place the tool holder at the desired position at a location inside the workspace or environment. The remaining three links make up the wrist of the robotic arm and are used to define the orientation of the robotic arm end points. For the purpose of analysis, the robotic arm will made of joints, which will be named as wrist, elbow, shoulder, and base.[4]

3. METHODOLOGY

It consists of an Atmega328 Microcontroller, Wi-Fi module, six DC Motors with driver IC and power supply. The pick and place robotic arm consists of a robotic arm placed on a moving vehicle. The vehicle is able to move along any type of surfaces irrespective of it is smooth or rough. It uses two motors for the operation and a belt type tire is attached to the vehicle like in the tanks, for the smooth and reliable operation. The pick and place arm uses four motors for the operation of the system, two for the operation of moving vehicle and two for the pick and place operation. The pick and place arm consists of an arm assembly with a jaw, which is only able to move in up and down direction. There are two motors are for the arm assembly, one for the up and down motion and other for jaw opening and closing. The maximum upward and downward motion is limited by a mechanical push button type switches. It breaks the motor circuit when the arm is at its maximum position beyond which the motor does not rotates. For the controlling of motor, motor driver IC and Arduino uno controller is used. The input signal or controlling signal is given from an android device, which is interfaced with the microcontroller by a blue tooth module.

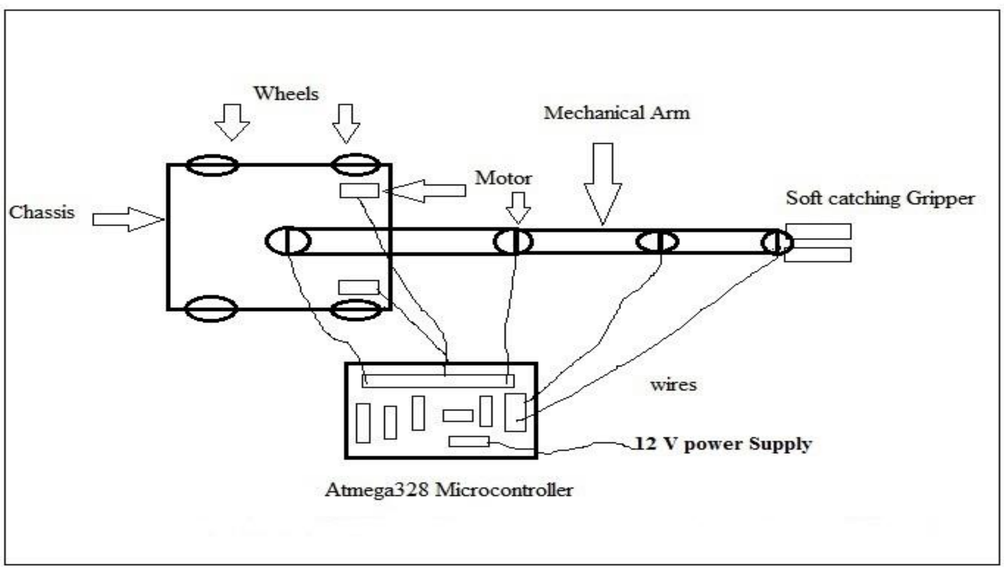

Fig. 3 : Schematic diagram of cell phone Controlled robotic arm with moving vehicle

4. MECHANICAL PARTS:

4.1 MECHANICAL ARM VEHICLE:

A **Mechanical arm vehicle** is an automatic machine that is capable of locomotion. Mobile mechanical arm have the capability to move around in their environment and are not fixed to one physical location. By contrast , industrial mechanical arm are usually more or less stationary, consisting of a jointed arm (multi linked manipulator) and gripper assembly (or end effector),attached to a fixed surface.

Mobile mechanical arm are a major focus of current research and almost every major university has one or more labs that focus on mobile mechanical arm research .Mobile mechanical arm are also found in industrial ,military and security settings. Domestic mechanical arm are consumer produts, including entertainment mechanical arm and those that perform certain household tasks such as vacuuming or gardening.

4.2 COMPONENTS OF VEHICLE:

4.2.1 BASE

Generally 2mm thickness metal sheet are used for making vehicle base.

The dimensions are taken as follows:

Length : 280 mm
Width : 220 mm
Height : 50 mm

4.2.2 WHEELS

Robotics wheels for 6mm diameter shaft. The rubber coated cover gives more strength to the wheel. Choose these wheels for your next 2WD & 4WD robot design, these are conceived for absolute versatility. Rubber thread bonded to the wheel makes it light weight and durable ,provides excellent traction, friction.These plastic wheels offer a low cost solution that is durable enough for a combat robot yet still light enough to be practical.

Wheel Diameter : 100mm
Wheel Width : 20mm
Shaft Diameter : 6mm

4.2.3 DC MOTOR

The DC motor are most easy to control. One dc motor will require only two dc signals for its operation, if we want to change the direction then we just need to change the polarity of the power across it. We can very speed by varying the voltage across the motor by making use of gears.

The dc motor does not have enough torque to derive a robot directly by connecting wheels to it, gears increases the torque at the expense of the speed

Mathematical interpretation

Rotational power (p)= Torque(t)*Rotational speed(w)

T=P/W

P is constant for dc motor with constant electrical power

Thus the torque is inversely proportional to the speed

T a 1/w

By using two motors we can movie robot in any direction ,the steering mechanism of robot is called differential drive.

4.3 MECHANICAL ARM

A Mechanical arm, have similar functions to a human arm ; the arm may be the sum total of the mechanism or may be part of a more complex robot.The links of such a manipulator are connected by joints allowing either rotational motion (such as in articulated robot) or translational (linear) displacement. The links of the manipulator can be considered to form a kinematic chain. The terminus of the kinematic chain of the manipulator is called the end effector (Gripper) and it is analogous to the human hand. The arm design with the help of sun board. Its picking process is done with help of 3 rpm motor placed vertically connecting both arms and another motor of 30 rpm to rotate arm 360 degree to put the object in the carrier. Here ,arm is to pick and place any object. Here aluminum material strip used for making two links of arm. This two links are connected to each other by still shaft inserted between holes provided at end of links. One –One hole on each link provided for mountain dc motor to drive the link.

4.4 COMPONENTS OF MECHANICAL ARM

4.4.1 STRUCTURE:

The structure of a mechanical arm is usually mostly mechanical and can be called a kinematic chain. The chain is formed of links ,actuators and joint which can allow one or more degrees of freedom. Most contemporary mechanical arm use open serial chains in which each links connects the one before to the one after it.These mechanical arm are often resemble the human arm. Mechanical arm used as manipulator have an end effector mounted on the last link.This end effector can be anything from a welding device to a mechanical hand used to manipulate the environment.

4.4.2 GRIPPER:

The gripper can be designed to perform any desired task such as welding, gripping ,spinning etc.,depending on the application. For example mechanical arms in automotive assembly lines perform a variety of tasks such as welding and parts rotation and placement during assembly.In robotics ,an gripper is the device at the end of a mechanical arm, designed to interact with the environment. The exact nature of this device depends on the application of the machine. The gripper means last link (or end) of the mechanical arm. At this endpoint the tools are attached.In a wider sense, an gripper can be seen as the part of a mechanical arm that interacts with the work environment. This does not refer to the wheels of a mobile of a mobile mechanical arm or the feet of a humanoid robot which are also not gripper they are part of the mechanical arm mobility.The gripper can be of two ,three or even five fingers.Surgical robots have gripper that are specifically manufactured for the purpose.

4.4.3 SPUR GEAR:

Gear-6mm Circular Shaft
Outer most diameter (Including teeth)-40mm
Shaft diameter-6mm
Coupling shaft diameter -15mm
Number of teeth - 25

5.DESIGN OF PROTOTYPE:

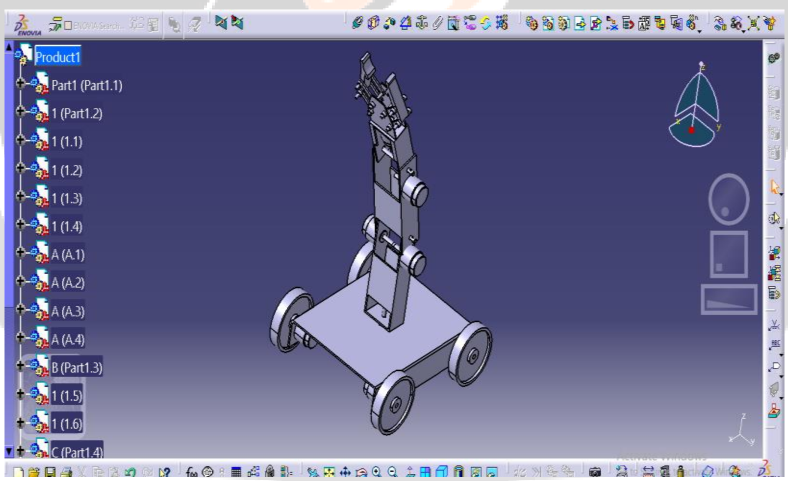

Fig. 4 : Design of Prototype

6. FUTURE SCOPE:

The robot so programmed for pick and place operation can be made versatile and more efficient by providing the feedback and making it to work on own than any human interventions. It can be made possible by image processing tool interfaced with this Arduino. The features that can be added on to improve its efficiency, make it operate on its own thought without any human intervention are line follower, wall hugger, obstacle avoider, metal detector, bomb diffuser etc.

7.HARDWARE IMPLEMENTATION:

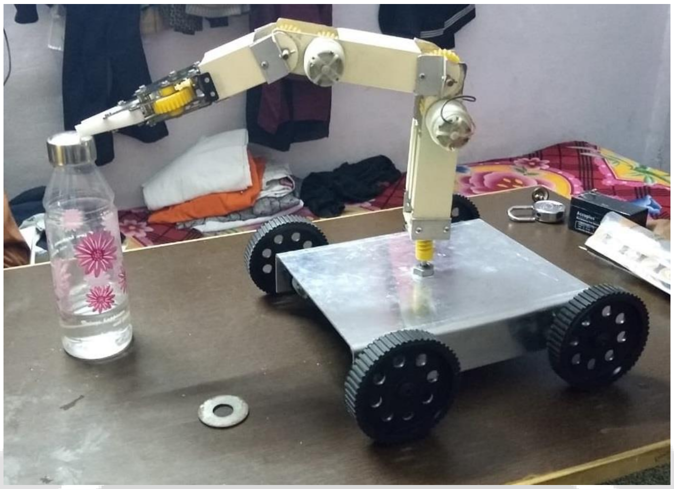

Fig. 5 Implemented project model

8. CONCLUSIONS

The proposed concept of pick and place robot using Arduino is implemented via RF play station. It is found that, the robot so implemented has the ability to locate itself to the location where the object to be lifted is available with the help of chassis and four dc motors. Further depending upon controlling action provided to servo motor it lifts the object and locates the same at required destination.

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