Implementation of Pick and Place Robot

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Abstract: The project is meant to develop a Pick and Place Robot which can be controlled using an Android phone. The prototype consists of a XLR8 Development Board, which is an FPGA based, microcontroller which is programmable in Arduino IDE, a battery source, motor drivers, motors, and a Bluetooth module. XLR8 is faster, higher performing, scalable microcontroller. The robot is capable of moving forward, backward, leftward, and rightward. The arm is capable of doing the picking and placing actions. An application called, "Arduino Bluetooth controller" is installed on the user's android device and the commands are given to the robot to pick and place the objects from source or required place to destination place. Bluetooth has a simple and user-friendly interface, and is easily available on any android phone so that a disabled person can access Bluetooth and use the robot of his needs.

IndexTerms **- Pick and Place Robot, XLR8 Development board, Arduino Bluetooth control, DC motor.**

I. INTRODUCTION

Disabled people always need a person to take care of them and be with them to do their works. It is impossible that a person can be available for someone all the time. Pick and Place robot can assist a disabled person so that they can give instructions to the robot and get their works done. This pick and place robot can pick the objects from one place to another place. Robots are meant for making the tasks easy and safer. Robots can replace the presence of a human and can do dangerous operations.
This robot can perform forward, backward, leftward, rightward, pick, and place actions.

II. LITERATURE SURVEY

Much number of researches has been done on Pick and Place Robotic arms for various applications. Many of them use Arduino, Microcontrollers, and ATMEGA16A microcontrollers. Below, are the few research papers from few journals:

2.1. Pick and Place Robotic Arm Using Android Device

From this paper we have found the possibility to control a robot using any android device. The robotic vehicle is golem application controlled for remote operation. All the transmitting end using golem application device, commands are sent to the receiver to manage the movement of the golem either to maneuver forward, backward and left or right etc. At the receiving end four motors are interfaced to the microcontroller where two are for the body movement. The golem application device transmitter acts as a far flung management that has the advantages of adequate vary, while the receiver end Bluetooth device is fed to the microcontroller to drive DC motors via motor driver IC for necessary work. Remote operation is achieved by Associate in Nursing sensible phone or Tablet etc., with golem OS; upon a GUI (Graphical User Interface) based bit screen operation. The main advantage of this golem is its soft catching arm that is designed to avoid additional pressure on the suspected object for safety reasons. Any the project are going to be augmented by interfacing it with a wireless camera so as that the person dominant it'll browse operation of the arm and gripper remotely**. [1]**

2.2. Android Controlled Pick and Place Robotic Arm Vehicle

In this work, the design of a robot is presented which will move around in four directions and is equipped with gripper for pick and place operation. These operations will be controlled by a user friendly interface present on operator's mobile phone. Depending upon the button clicked on the application, proper motional commands are given to robot by microcontroller. This project is in aimed to design and develop a mobile robot which can move according to the button pressed on App. This prototype can be employed in chemical industry for handling of chemical materials of hazardous nature, or for movement of heavy objects in any industry. [2]

III. COMPONENTS REQUIRED:

1. **XLR8 Development Board:**

   The developed source code is dumped on to the board so that it can give instructions to the robot. Commands are given to the robot by the user using a Bluetooth application "Arduino Bluetooth controller". This application is available for free in the Google play store.

   The source code is developed in the Arduino IDE using Embedded C. XLR8 is re-configurable according to our requirements. The timing parameters can be varied according to the required application. [3]

2. **Bluetooth Module:**

   Bluetooth module HC-05 is used which is a serial communication device. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. These modules can be used at various baud rates such as 9600 to 460800 but the default baud rate is 38400. The module is

typical -80dBm sensitive, has RF transmitter power up to +4dBm, operated at low power 1.8V,1.8 to 3.6V I/O and it is PIO controlled, UART interface with programmable baud rate. [4]

3. **Battery Source:**

Rechargeable Battery source of 12V is used and is reduced to 5V using Voltage Regulator 7805, as the components XLR8 and Bluetooth takes 5V and not more than that.

4. **L293D Motor Driver:**

L293D is a motor driver circuits. This is a combination of a 8051 microcontroller, a 1k and a 10k resisters. The input to the base of the transistor is applied from the microcontroller port pin P1.0. The transistor will be switched on when the base to emitter voltage is greater than 0.7V (cut-in voltage). Thus when the voltage applied to the pin P1.0 is high i.e., P1.0=1 (>0.7V), the transistor will be switched on and thus the motor will be switched ON. When the voltage at the pin P1.0 is low i.e., P1.0=0 (<0.7V) the transistor will be in off state and the motor will be switched OFF. Thus the transistor acts like a current driver to operate the motor accordingly. The pin diagram with inputs and outputs is given below

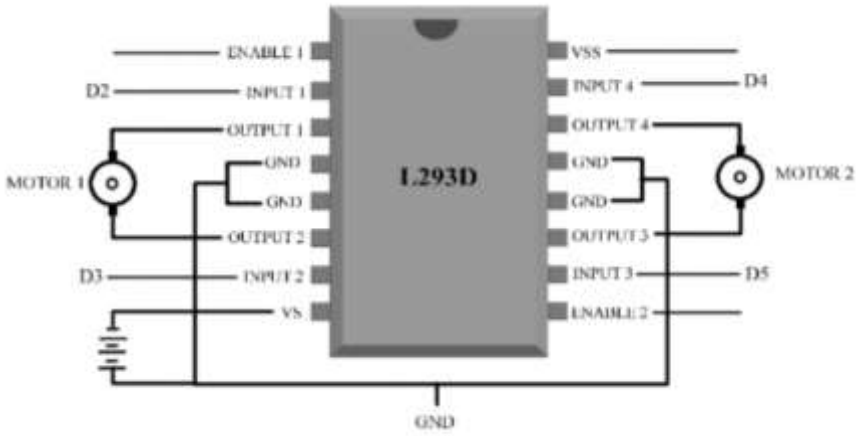

Fig.3.1. L293D Motor Driver

5. **DC Motors:**

As per the required application the robot need to perform 8 operations so we need 4 DC motors. Two motors does the robot movements i.e., forward, backward, left and right actions. And two other motors are required for arm movements such as up, down, hold, and leave actions. A DC motor works on the Fleming's Left hand principle. The **first finger** points in the direction of the **magnetic field** (first - field), which goes from the North pole to the South pole.
The **second finger** points in the direction of the **current** in the wire (second - current).
The **thumb** then points in the direction the wire is **thrust** or pushed while in the magnetic field (thumb - torque or thrust).
The motor drives the worm gear so that the arm can open and close, move up and down and similarly forward and backward movements. It is common for worm gears to have reductions of 20:1, and even up to 300:1 or greater.

6. **The Robot and Arm Assembly:**

The complete prototype is an assembly of robot and an arm as shown in the figure. The robot has four wheels which are driven by two motors.

Fig.3.2.Pick and Place Robot prototype

IV. SCHEMATIC DIAGRAM:

The above schematic gives the details about the pin to pin connections of the prototype. 12V from the battery source is reduced to 5V, using Voltage regulator 7805, and is given to XLR8 board and Bluetooth. XLR8 board takes 8 inputs (Input1, Input2, Input3, Input4, Input5, Input6, Input7, Input8), and the first two pins are used to receive and transmit the data from Bluetooth.

First, four input ports are given to the first L293D and next four inputs are given to the second L293D. Each L293D gives four outputs. One motor is given two of the outputs from L293D as input. So one L293D can drive two motors. The prototype requires four DC motors as per the application. Two motors to drive robot and two motors to drive the arm of the robot.

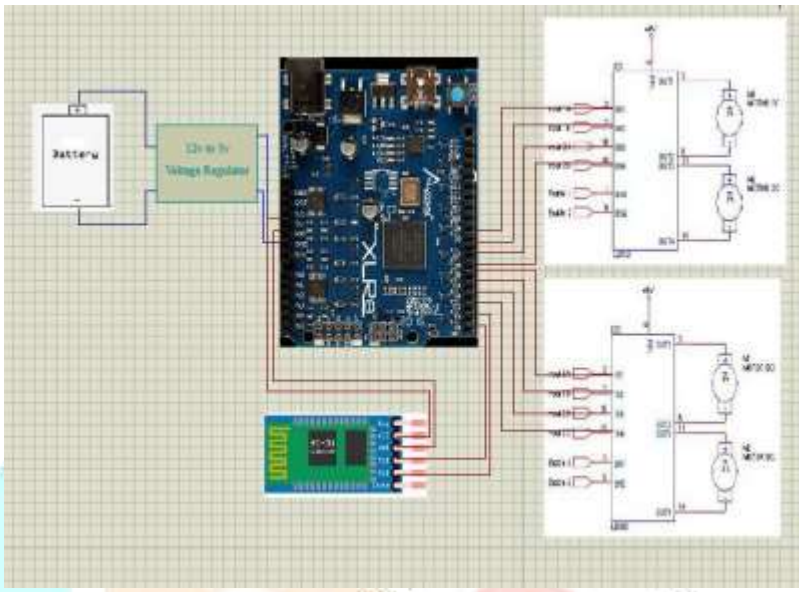

Fig.4.1 Schematic of the prototype

V. WORKING

When we switch on the power supply a 12V DC power is generated, as the XLR8 is compatible to 5V DC or 3.3V DC, hence to step-down the voltage, we are using voltage regulator circuit, which consists of 7805 IC so as to produce 5V pure DC voltage. On the XLR8 board, we are using 10 digital pins to control the L293D ICs and an HC-05 module. The transmitter of the XLR8 is connected to the receiver of the Bluetooth module and similarly, the receiver of the XLR8 is connected to the transmitter of the Bluetooth module, which facilitates a serial mode of communication. The digital pins D2-D5 pins are connected as inputs to one of the L293D and D6-D9 pins are connected as an input to another L293D, which controls all the movements of the robot. A 12V DC supply is fed to both L293D driver IC's to drive the motors with the sufficient voltage.

5.1. The Logic of the Robot and Arm movements:

Movement	In-2	In-3	In-4	In-5	In-6	In-7	In-8	In-9
Forward	1	0	1	0	0	0	0	0
Backward	0	1	0	1	0	0	0	0
Leftward	1	0	0	0	0	0	0	0
rightward	0	0	0	1	0	0	0	0
upward	0	0	0	0	1	0	0	0
downward	0	0	0	0	0	1	0	0
hold	0	0	0	0	0	0	1	0
leave	0	0	0	0	0	0	0	1
stop	0	0	0	0	0	0	0	0

Table5.1. Logic Table

In-2, In-3, In-4, In-5, In-6, In-7, In-8, In-9 are the inputs where In stands for input and 2,3,4…9 numbers denotes the pin number on the XLR8. The pins 0 and 1 are the transmitter and receiver pins which are connected to the Bluetooth module. In the table, 1 denotes voltage HIGH and 0 denotes voltage LOW. Each command has specific logic value and that particular operation is done when it receives the command from the user. When the command given by the user matches the character (i.e., forward, backward…) then the particular logic values are digitally written and give output to do that particular operation.

5.2. Flow Chart:

Switch-ON the power supply, then the three LEDs on the robot glows, one on the voltage regulator, another on the XLR8 board and on the HC-05 module. The Bluetooth waits for the command that should be given by a paired Bluetooth android device. If there is no character received then it stays in its "Ideal State", if a character is received from the user then the character is compared with the characters which are given in the instructions. Then the character is checked whether it is a robot action command or arm action command and then the operation is performed according to the given command until the user says to stop it continues to do that action.

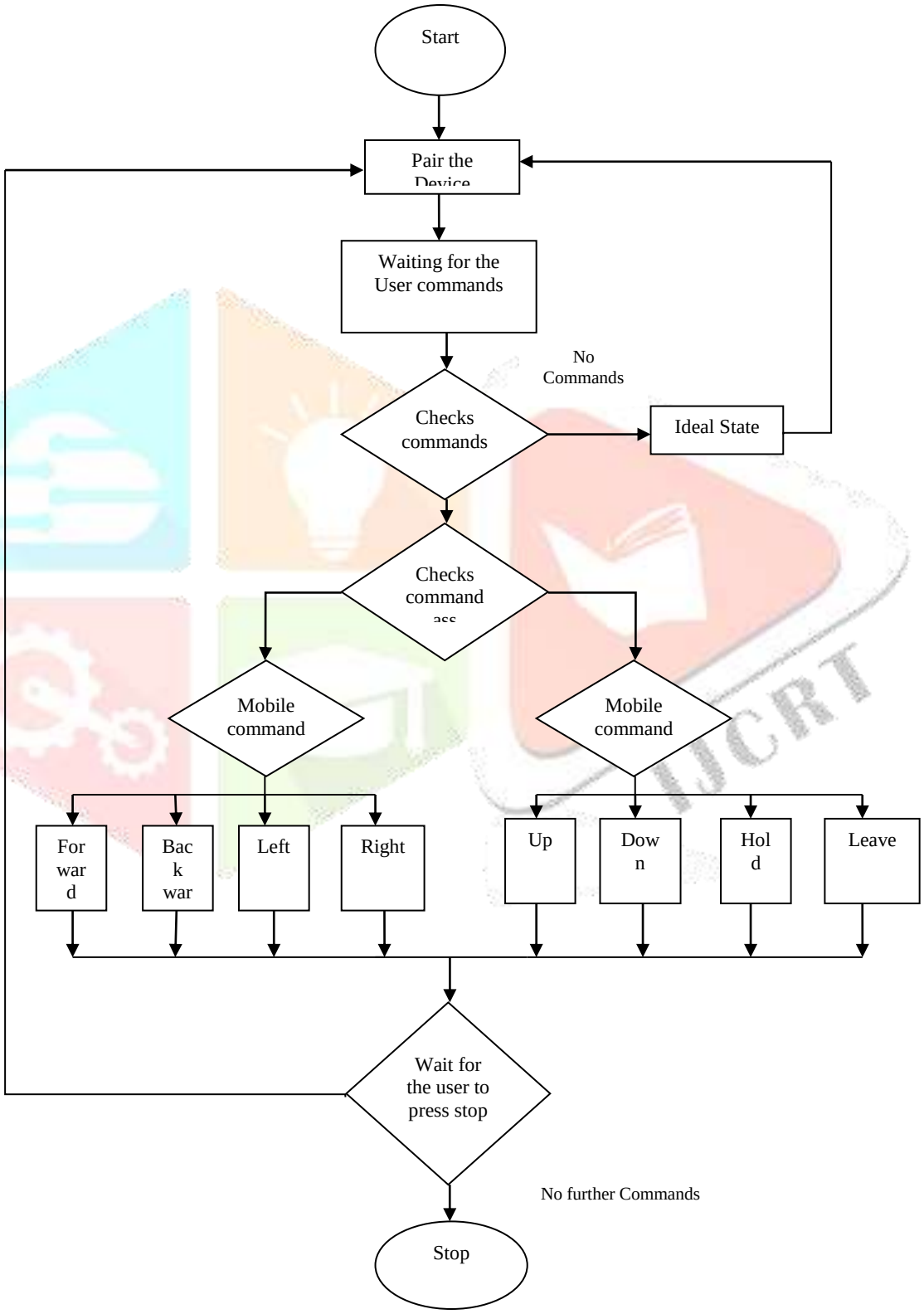

Fig.5.1. Flowchart

The following figures are the snapshots of the application which is used to control the robot.

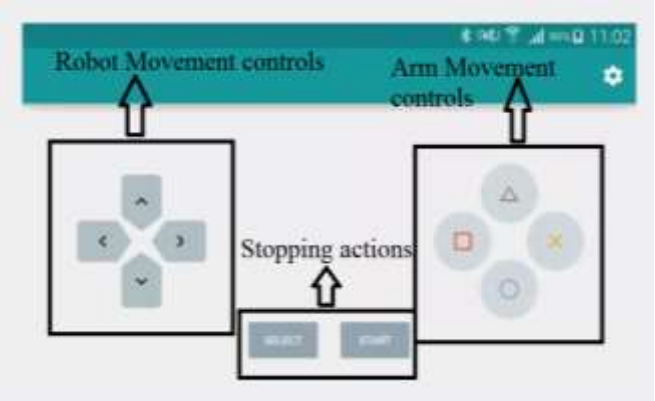

Fig.5.2

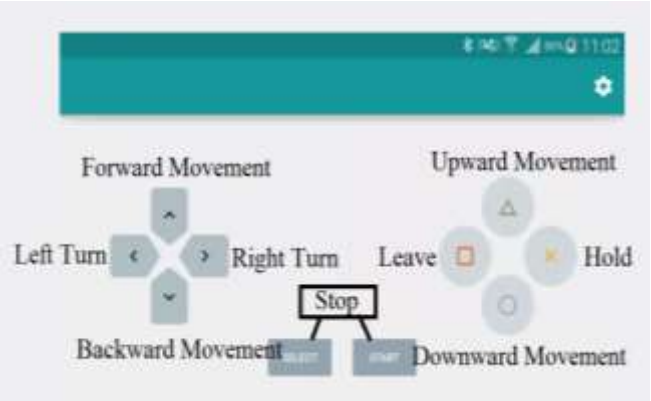

Fig.5.3

Fig.5.2. Commands for Robot and Arm movements and Stopping actions

Fig.5.3. Commands and their operations

VI. RESULTS

The following figures are the snapshots of results or output of the prototype while picking and placing the objects. Here we are considering cylindrical and light objects for testing the robot.

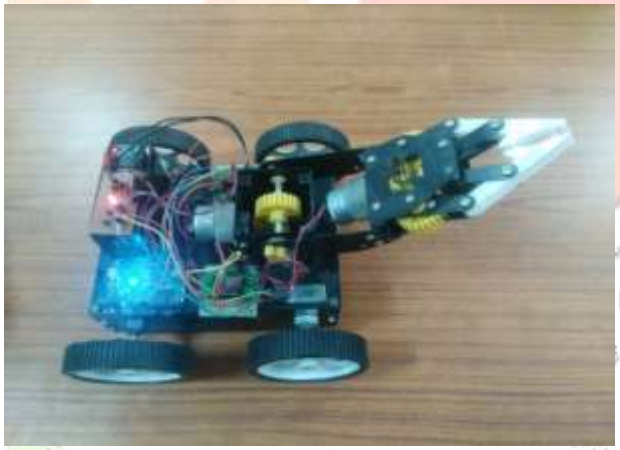

Fig.6.1. Robot Prototype

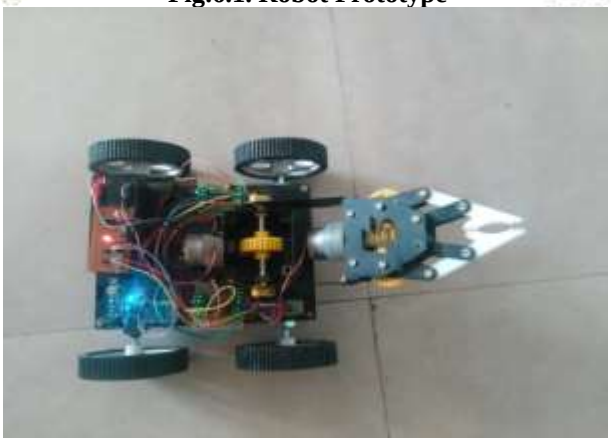

Fig.6.2.Closing action

Fig.6.3.Opening action

Fig.6.4.Picking Action

Fig.6.5.Placing Action

VII. ADVANTAGES

Faster:

Hardware-accelerated functions run in a fraction of the clock cycles required to execute the same function in software. This results in faster overall application speed.

High-Performance:

Shorter times to complete complex tasks in hardware result in more clock cycles available for additional software functions. This effectively improves overall computational performance.

Scalable:

The functionality and capabilities accelerated in the FPGA hardware can be expanded and scaled for many different applications. We are just scratching the surface of what is possible to accelerate.

VIII. LIMITAITONS

- The vehicle can be operated only within the range of Bluetooth. A Wi-Fi module can be replaced with Bluetooth to get the more operational range.
- The vehicle is not able to pick up heavy loads, as the prototype is a simple one. To lift up heavy objects, the prototype can be implemented with heavy mechanical machinery. This is more useful in manufacturing industries.
- Objects having smooth surfaces are difficult to handle, to avoid this problem the surface of the hand gripper can be made rougher so that it is capable of holding objects.

IX. FUTURE SCOPE

- **Industrial Robot:**
  An Industrial Robot that can be used to pick heavy machinery which can be operated using an Android application. As said in the previous chapter, a Wi-Fi Module can be included for a better range of operational area.
- **Bomb Defuse Robot:**
  Bomb Defuse Robot can be made using this prototype by interfacing camera. A person can defuse a bomb using this robot even by staying far from the bomb. A camera is used for the user visibility of the bomb.

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