Abstract: The work is designed to develop a pick and place dual arm tele robotic 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, left, right, up, down, open, close, center motor rotate right and left. At the receiving end seven motors are interfaced to the raspberry pi processor where four of them are used for two arms and two 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 Wi-Fi device is connected to the processor 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 (App Name: TCP/IP Terminal).

Keywords: GUI (Graphical User Interface), TCP/IP Terminal.

I. INTRODUCTION

The rapid growth of industry and advancement of technology has resulted in reduction of human efforts, the main reason for which being machines!! Machines are playing an important role in our life. A machine might be anything, be it a cell phone or a bike or even a robot. Robots have found an increasing demand in a wide range of applications in our life. Their use in defense has increased by the day. Our paper includes one such instance of how a robot can be of use to human race in general. Robots ensemble human beings in many ways be it looks or functioning, but previously robots were not controlled by computer programs or electronic circuitry. Back then they were built using principle of mechanics improving over time with the coming of electronic age. In today’s world, robots find use in various places be it to detonate buried bombs or in industrial applications or even robotic components used in children’s toys. The complexity of computer software depends on how difficult the robot’s tasks are. In this project we use internet to establish communication between the user and a robotic vehicle. This is a reliable connection and a continuous video feedback is available to control the robotic vehicle. Due to the use of internet, there is no limitation on range or distance between the user and the robotic vehicle. Internet robotics has opened up a completely new range of real-world applications namely tele-surgery, tele-manufacturing, tele-training, tele-surgery, traffic control, health care, space exploration, disaster rescue etc. and the list is supposed to increase further in the coming years.

In the proposed system of robotic vehicle with dual-arm robotic arms, the cost of the system will vary according to the size of the vehicle, arms and its capability where we consider those arms based on the weights of the objects to be carried out with robotic vehicle. The manufacturing industries needs to carry heavy weights because of their products and materials are huge and robust; there we need the arms nearly in a size of heavy lifters. In our system, we are implementing a robotic manipulator which can hold a small item with its arms and place them according to the given control command by the user. The most advanced and outstanding aspect in our robotic system is its remote control with Android mobile. The remote control is a very important concern in robotic systems implementation. According to the how much range we want to control the robot, we need to select an optimal solution for remote control technology. The reason behind choosing the Android mobile as a remote control is the increased usage of smart phones all over the
world. The smart phones are making their significance everywhere in the world, they can be used for many purposes and now it’s our turn, we are using an android smart phone as remote control for our robot.

An android application would be installed in a mobile phone, which will have all the necessary control buttons for the robot movement and pick and place functionality. The mechanical arrangement of the robotic wheels consists of DC motors, which will be operated in required directions through a motor driver circuit connected from the microcontroller. In the robotic system, we used Raspberry Pi processor because of it is having less power consumption. The processor acts as a heart of the robot, all the controlling and processing of tasks can be done by the microcontroller. The tasks like getting the input from android phone, analyzing the commands and give the instructions about the robot movement according the received command from the android phone. The communication technology used between the robot and the android phone is Bluetooth, which is tends to be use in the system because its presence in any mobile almost as well in any smart phone. A Bluetooth module is to be connected to the robotic system. While comparing with the other wireless technologies like Wi-Fi or ZigBee, they may not be present in every smart phone and they will be so expensive compared to the Wi-Fi. Moreover the Bluetooth works based on unlicensed spectrum of frequencies around 2.4GHz and is very useful in case of short distance communication.

II. BACKGROUND AND LITERATURE REVIEW

A. Robotic Arm

Robotic arm is a type of mechanical arm, usually programmable, with similar functions to a human arm. Types of robot arms depend on their range, working capability and reach. Cartesian robot is used for dual-arm work, plotting and handling arc welding. Its range is mostly 2 dimensional. Cylindrical robot is also used for the above mentioned working categories, but since it operates in a cylindrical coordinate system, it can be used to do the operations more precisely and accurately, furthermore it also has a wider reachable range. Spherical robot works on the polar coordinate system. SCARA robot is mainly used for dual-arm work. It has to parallel rotary joints to provide flexibility in a plane. Then for a three dimensional reach it is usually combined with other mechanisms. Articulated robot has three rotary joints. Parallel robots are used in the mobile platform handling cockpit flight simulators. It is a robot whose arms have concurrent prism shaped or rotary joints. Anthropomorphic robot - This resembles a human hand, with independent fingers and thumbs.

B. Robotic Arm Grippers

Gripper is an end-of-arm device often used in material handling applications. Generally, the gripper is a device that is capable of generating enough grip force to retain an object while the robot performs a task on the part such a pick-and-place operation. Any gripper must be capable of performing the task of opening and closing with a prescribed amount of force over many years of daily operation. The most commonly used grippers are finger grippers. These grippers generally have two opposing fingers or three fingers like a lathe chuck. The fingers are driven together such that once gripped any part is centered in the gripper as shown in Figs.1 and 2. This gives some flexibility to the location of components at the pick-up point. Two finger grippers can be further split into parallel motion or angular motion fingers.

Fig.1. Robotic ARM Base.

Fig.2. Gripper Design.

Angular jaw gripper open and close around a central pivot point, moving in an arcing motion. An angular gripper is used when there is a need to get the tooling out of the way. The advantage for an angular gripper falls on its simple design and only requires one power source for activation. However, it has several disadvantages including jaws that are not parallel and a changing centre of grasp while closing. Meanwhile, parallel jaw gripper moves in a motion parallel in relation to the gripper’s body. A parallel gripper is used for pulling a part down inside a machine because the fingers fit into small areas better. An advantage of parallel type gripper is that the centre of the jaws does not move perpendicular to the axis of motion. Thus, once the gripper is centered on the object, it remains centered while the jaws close. Space constraints might lead to the use of parallel over angular.
C. Working

The block diagram of the proposed system. It consists of a raspberry pi, Wi-Fi adaptor, four DC Motors with driver IC and power supply. The dual arm tele robotic consists of 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 tanks, for the smooth and reliable operation. The dual-arm tele robot uses four motors for the operation of the system, two for the operation of moving vehicle and four for the pick and place operation. The dual-arm tele robotic 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 forth 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 rotate.

III. METHODOLOGY

The webcam will capture live data with regards to its surroundings and then send it to a desired device through internet. The user will be observing this data on the monitor at the user end. According to the desired movement, the user will control the robotic vehicle and the robotic arm through the webpage or keyboard available at the user end. The input given through the webpage or the keyboard is then sent through the internet and the desired movement occurs at the robot end.

A. Proposed Block Diagram

The first part is construction of the robotic vehicle. With the help of programs an internet connection is established between the robotic vehicle and the user. Then robot captures the images using a webcam and stores them into the memory. The next task is to capture and send live images using internet at a rate sufficient to make them seem like a live video to the human eye. This was initially implemented using LAN before moving to internet. The desired result was achieved by sending compressed low resolution images so that transmission would not be affected in case high upload speeds were not available. Then the program was made more dynamic by varying the resolution of the images to be transmitted depending on the upload speed available at that particular time. Like for example in case of availability of good upload speeds, high resolution images will be sent and vice versa in case of low upload speeds.

IV. DESIGN AND IMPLEMENTATION

A. Raspberry Pi

Raspberry Pi is used for making robot wireless and web based. Webcam is interfaced to the Raspberry Pi and then the videos are transmitted wirelessly from the robot to the user’s monitor, from where the user can conveniently control the robotic vehicle’s movement and also the robotic arm movement. Raspberry pi is connected with the dongle which enables raspberry pi to transmit over the web network. Raspberry Pi uses an SD card for booting and for memory as it doesn’t have an inbuilt hard disk for storage. Raspberry Pi requires 5 volt supply with minimum of 1000 mA current and it is powered through micro USB cable. ARM11 only requires 3.3 volt of supply which it takes with the help of linear regulator. 5 volt is required for the USB ports. It operates at 1.3GHz We use python or embedded C to write the code into the raspberry pi. It has a strong processing capability due to the ARM11 architecture and Linux-based system. In terms of interface and control, it has 1 SPI, 1 UART, 1 I2C and 28 GPIO, which basically meet the control requirement. There are easy to use open source peripheral driver libraries.

Robotic Arm: It should have three rotational joints along with a gripper. The gripper will open and close by means of the gear wheels. The base rotates in circular direction and the other two joints for upward, downward and forward, backward motion respectively. There is a limit to the movement each joint can produce since each joint is controlled by a servo motor.

Web Camera: The visual feedback is provided by the Intex IT-306WC webcam. It can have a resolution of up to 30.0MP, Frame rate of 30FPS along with night time vision. It is plugged into the USB port of the Raspberry Pi.

Motor Driver Circuit: This circuit consists of the motor driver IC 1293d used to power the DC motors. These DC motors will be used to maneuver the robotic vehicle.

B. Software Design

Python programming is used Here: Software design is divided into 4 codes namely:

Webcam Server: Webcam Server is the code run in the Raspberry Pi to capture the images and stream them over the internet. Here the images will be compressed into .jpg format to reduce their size prior to their transmission over the internet. They are sent using byte array over the UDP socket.

Webcam Client: Webcam Client is the run in by the user to receive these images in the form of byte array. There then displayed on the monitor at a rate closer to 12-20 images per second so that they appear like a continuous video.

The major building blocks of this project are:

- Rechargeable Battery for Power Supply
- Raspberry Pi 3 Processor.
- DC Motor with driver.
- Robotic ARM Grippers
- PIR Sensor
- Buzzer with Driver
- USB camera

Software’s used:

- Raspbian Jessie OS.
- Python Programming Language.
- Express SCH for Circuit design.
V. CONCLUSION

Paper contains detailed information for controlling a robotic vehicle guided via internet. It has been done with the use of TCP and UDP protocols for transport layer data transfer. The size of the images sent by the robotic vehicle is controlled by a feedback. This feedback signal determines whether the size of the image should be small or large depending on the upload speed available with the Raspberry pi, thus making it much more dynamic to stream live visual data along with the successful movement of the robotic vehicle and the robotic arm. Faster communication will ensure that we can send high quality, high resolution images with minimal delay or latency. This will help reduce delay in execution of commands providing real time access to the robot. It will be of great use for monitoring illegal activities occurring around us. It will also be useful in disaster affected areas to find and rescue injured people. It would also be used for spy bot.

VI. REFERENCES


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Raspberry Pi Based Dual-ARM Tele Robotic System with Live Video Streaming

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