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IoT Based Dual Arm Tele-Robotic System

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***Abstract*—The world has come close with the new technologies and one of it is the Internet of Things(IoT). This paper proposes a tele robotic vehicle with a pick and place dual arm and video surveillance application using Arduino Mega. The robotic vehicle at the application end is interfaced with the cloud and at the user end with mobile applications. Internet is used as a Wi-Fi as a medium. Previous systems used Bluetooth, Zigbee, LAN which has a short range, higher power consumption and systems are unable to operate in the real time. Tele – robotic system gives the idea where the user can control the robot without being present at the application area. The software itself is the core of IoT which defines each device identically. Dual arm soft catching gripper is designed for the pick and place application, it avoids the extra pressure on the suspected objects. Online surveillance is possible with the IP camera. ESP8266 Wi-Fi module is used as internet medium. Client manages the robotic vehicle from a distance through a remote – an android Blynk application to move forward, reverse, left, right, stop, pick and place. GPS is used to trace the location of the robot in the application area. Ultrasonic sensors detect the obstacles in the way of the robot and stops it from falling from a depth and also prevents it from colliding with the obstacle. Arduino Mega serves as the microprocessor as well as a server. The control of the robotic vehicle is performed by means of different commands and applications.**

***Index Terms*— Arduino Mega, Blynk, Internet of Things(IoT), Local Area Network(LAN), Tele-Robotic, Wi-Fi**

I. INTRODUCTION

Growth in the advanced technologies has resulted in the reduction of the human efforts. Robots are playing an important role in our regular life. Robots has wide applications in the field of industries, agriculture, military, home automation and many more. Arduino is a open source, user friendly platform which provides the flexible development kits and schematics. Arduino can be used by anyone without having more knowledge of coding. Arduino is based on C and C++ coding. Arduino helps in making the interactive environment with the use of different sensors and different modules. It can also easily interface with the internet. Robotic vehicles can be carried by an individual as they are light in weight and portable [6]. Using Arduino has the lesser limitations and more reliability. It can be used in the real time operation.

The cloud service makes the interface more easy. There is no problem of jamming in cloud as it uses two queues for functioning one to transmit the data and another to receive the data. ESP8266 Wi-Fi module easily gets interfaced with the Arduino. Android Blynk application is used as remote control installed in a mobile and can be used at the user end to give the commands to control the movement of the robotic vehicle as well as pick and place operation. Cloud robotics is a centred technology used for the greater memory storage, operates in two way communication without jamming for the robotic applications [8]. The robot has its application in military. At present in the war like environment and in the hazardous situations robotics play a important role by saving the human life. These robots are helpful for object pick and place, obstacle and leakage detection [1]. The vehicle can be easily located in its user interface and the user can continuously fetch the feedback data related to the vehicle [3]. The use of Internet does not have any limitations of range as if we have the internet access, we can control the robot from anywhere as the project is totally based on IoT. The video captured by the IP camera should be processed very fast to provide real time visualization of the surrounding to the user. Also the pick and place operation is done in a clean manner with the use of soft catching gripper. The Internet of Things (IoT) is a wireless technology connecting everyday accessible physical objects to internet. IoT wide spreads the connectivity of internet through the mobile phones, sensors, laptops, actuators etc.

Paper [1] presents a synopsis on robot rescue in the application domain of the Human Robot Integration (HRI) and also present the HRI issues. Paper [8] presents a robotic vehicle able to move in multiple directions by means of commands using Raspberry Pi as master and Arduino Uno as slave and internet for Wi-Fi. Paper [9] presents a Internet of Things (IoT) robotic arm where the robotic arm is controlled by a nurse in the hospital in the guidance of a doctor by the time of operation and can also

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perform pick and place task.

II. FRAMEWORK OF THE SYSTEM

Arduino Mega is a open source microcontroller used to observe the tasks through sensors, actuators etc., send the commands to the user end and operate the robot according to the user commands. It is powered by micro USB cable. The robotic unit consists of DC motors, Arduino, ESP8266 as a Wi-Fi medium, dual arm soft gripper, an IP camera, the H – bridge L293D motor driver module. The User end consists of a android mobile with internet, Blynk application and IP camera application. Blynk application is the intermediate remote between the user and the robotic vehicle. The user adds the virtual pins in the Blynk app according to the application, by pressing those virtual pins on the app firstly the commands go to the cloud and then to the Arduino through ESP8266 Wi-Fi modem and then for example to the DC Geared motors [7]. With the help of online video surveillance it is possible for the user to take the right decisions for the movement of robotic vehicle as well as can do the task of pick and place. And this is the presence of tele – robotic system in the project.

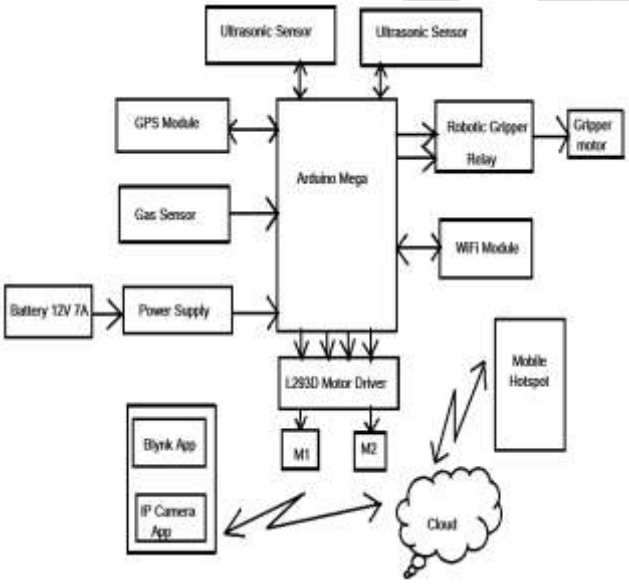

Figure 1 : Block Diagram of IoT Based Dual Arm Tele-Robotic System

III. CONSTITUENT SUB MODULES

Microcontroller:

Arduino Mega is used as a microcontroller. It is a user friendly mini-computer. Arduino is based on simple and user friendly basic programming languages such as C and C++. It has 54 digital inputs/outputs and 14 analog inputs/output pins. It has 3 serial ports which are necessary for our project to connect with Wi-Fi module, GPS module and the ultrasonic sensor.

Power Supply:

The robot requires 12V 7.5 A battery. As the DC geared motors operate on 12V and the IP camera requires 2A of current. By doing a research on the current and voltage distribution for the robotic vehicle we require this power supply battery. It is a rechargeable battery.

Sensor Module:

The sensor module comprise of the ultrasonic sensor and the MQ-6 gas sensor. Arduino takes the appropriate action according to the commands given by the user. For example: it continuously senses the forward and reverse distance to avoid any obstacles. GPS locates the location of the robot. Gas sensor continuously senses gas in the environment.

- Ultrasonic sensor: 2 ultrasonic sensors are used. One for the forward obstacle detection and another for the reverse depth detection. Ultrasonic sensor transmits the signal(triggers) and when obstacle detected receives(echo) the signal. It can detect the obstacle on 2cm to 400cm distance.
- MQ-6 sensor: MQ-6 is a gas sensor. It can detect the harmful gases like LPG, propane, iso – butane present in the application field.

Communication Module

Communication is possible with the use of ESP8266 Wi-Fi module. Cloud interface makes possible the Internet of Things. The Wi-Fi module enables both video as well as the data transmission by using Blynk and the camera app. GPS helps in tracing the location of the robot. The commands are send manually through the Blynk application. The Blynk app is installed in the mobile. It is interfaced with cloud to the robot which is present in the application area. Virtual buttons are present on the Blynk app just by pressing the buttons the action takes place in the application area via the internet medium. It can perform the operation of Forward, Backward, Left, Right, Pick, Place and Stop.

Robotic Car Movement:

L293D is used as a driving module. L293D is a H-bridge to drive two DC geared motors. The RPM of the motor decides the speed of the vehicle. 30 RPM motors are used to drive the robot.

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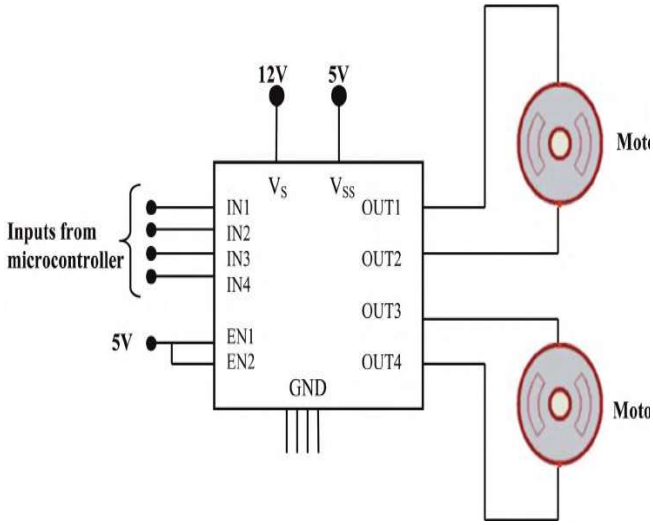

Figure 2 : Robotic Movement using H-Bridge L293D

Table 1: Robot Movement

Pin No / Sr. No.	18	19	20	21	Movement
1	0	0	1	1	Forward
2	1	1	0	0	Reverse
3	0	0	1	0	Right
4	0	0	0	1	Left
5	0	0	0	0	Stop

Pick and Place Module:

Object Pick and Place operation is most important rescue application in the field of robotics. It performs the jaw opening and closing of the dual arm gripper. A relay and a motor is assembled for jaw opening and closing. The working of a relay based DC motor is based on the H-bridge arrangement. The polarity within the load can be altered in both directions with the help of H – Bridge circuit. It works on the principle of Single Pole Double Throw (SPDT).

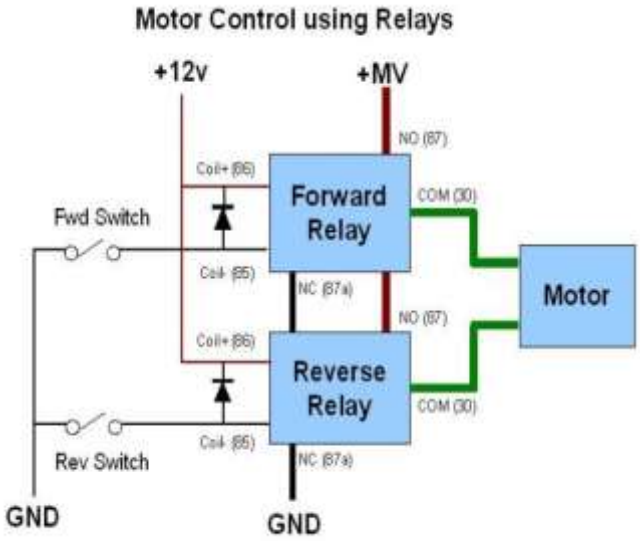

Figure 3: SPDT Working

The DC motor terminals in the motor driver circuit are connected between the common poles of two relay in the SPDT motor driver circuit. The Normally Open (NO) of both relay are connected to the positive terminal while the Normally Close terminal is connected to the ground or the negative terminal. Two PNP transistors are used in the circuitry connected to the coil carrying 5V supply.

Table 2: Modes of operation for jaw opening and closing:

S1	S2	Motor Movement
0	0	Motor does not operate
1	0	Clockwise direction of motor means the Gripper jaw closes
0	1	Anticlockwise direction of motor means the Gripper jaw opens
1	1	Motor does not operate

Wireless Video Transmission Unit:

Wireless IP Camera is used for the surveillance purpose. It is mounted on the robotic car. An Internet Protocol camera is a high bandwidth digital video camera. It has its uses for online streaming, capturing and recording videos and for surveillance. Cameras which are capable to access surveillance over the internet connection are the Internet Protocol cameras or net cams. It is connected wirelessly through cloud service to the ESP8266 Wi-Fi module. Video can be continuously streamed on the camera application.

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Here in this project Mi Home security camera is being used. It provides with 360° horizontal view and 96° vertical view rotation. 1080 high resolution picture quality. It is a night vision camera with motion detection and can also record videos. It has the easy installation steps. Video can be streamed on the Mi Home application.

Result:

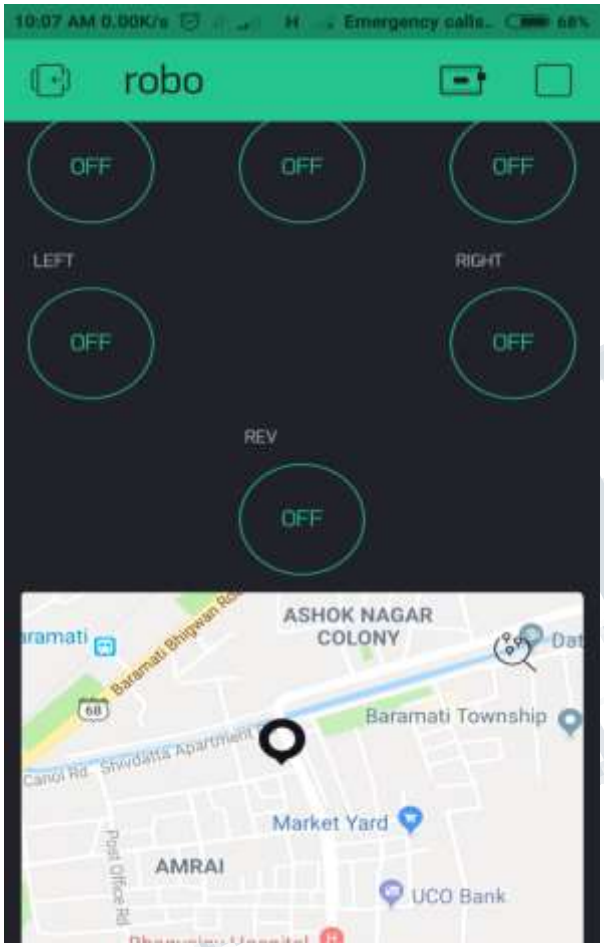

Figure 4: Screenshot of the Blynk application

Figure. 4 shows the Screenshot of the Blynk application. It consists of different functional Virtual Buttons like forward, reverse, left, right, pick and place. It also shows the GPS map location in a single application.

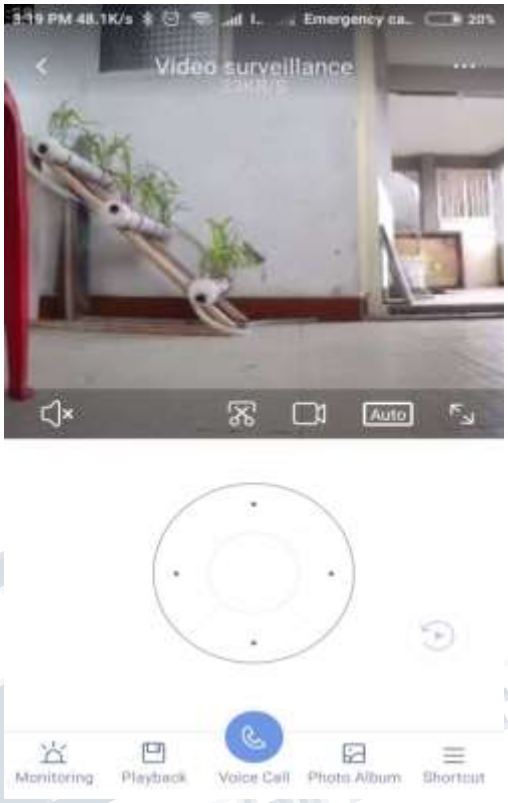

Figure 5: Screenshot of the camera app

Figure 5 is the screenshot of the camera application while capturing the online video.

Figure 6 : Image captured when pick command was given

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Figure 6 shows the image captured when pick command was given. It holds the object in its gripper.

IV. CONCLUSION& FUTURE SCOPE

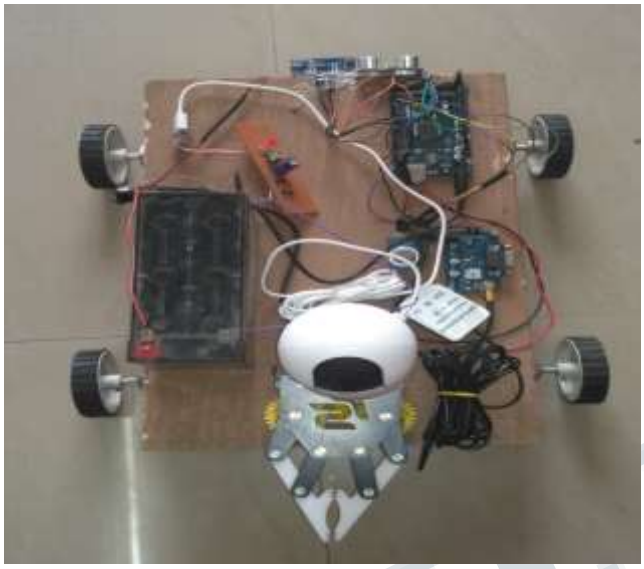

Figure 7: Image of the Proposed Hardware

In this paper, the framework for making a robot for pick and place and for surveillance purpose is successfully implemented. The problem of limited range for surveillance is resolved by using the concept of IoT. The robot can be controlled with the help of mobile / laptop manually. Our proposed robot is small in size thus is portable into area where human access is impossible. Wireless technology is the most integral technology in the electronics field. This technology is used to serve our project as a supreme part of pick and place and surveillance act. This provides a cost efficient and highly effective robot that replaces human work and reduces human labour and performs monitoring works in a well effective manner.

In Future the project has advancement in implementing the following ideas:

- The robot can be implemented with a laser gun for the self defense and to protect our nation from enemies, the IP camera will do the surveillance immediately after detecting the enemy laser gun will shoot the enemy and this operation can be done automatically or manually.
- The robot implemented with artificial intelligence will be able to recognize the environment, the borders, the application field and if detects any intruders it can alert the human operators.

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