Robotic Arm Control using Bluetooth Device with an Android Application

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***Abstract*- In industrial robotic environments, there are many different robots performing a variety of tasks. In all industries man handling works are transferred to machine handling works. Next, how to handle and control these machines or robots in easy access, that can be done by various techniques. The user must obtain access to the teach pendant or terminal to monitor the changes and to control the status or make minor changes to the programming of the robot. In this paper, smart phones and android tools are proposed as an innovative way to restrain industrial equipments. This paper introduces an android application, which provides the easy platform for user to communicate with robots. The application creates the ease-use graphical user interface to interrogate with industrial electronics. Robots and mobile application talks with other through Bluetooth wireless standard (IEEE.802.15.1*)**

Keywords*- *wireless communication; Robotics; Android; Bluetooth.

I.INTRODUCTION

Robots are smart machines that can be programmed and used in many areas such as industry, manufacturing, production lines, or health, etc. These robots perform hard, dangerous, and accurate work to facilitate our life and to increase the production because they can work 24 hours without rest andcan do works like human but more precisely and with less time. The idea of this research is to exploit robotics usage on heavy industries to help mobility of heavy objects from one place to other place. To a lay-person, the teach pendant can be an intimidating and complex device which diminishes a ‘typical’ manufacturing plant employee’s abilities to modify the robot’s functionality. Furthermore, each robot manufacturer provides its own unique and proprietary programming interface. In an effort to rectify these issues, this paper introduces a software architecture which allows Android clients to view, edit, and monitor industrial robotic functions, robotic programming wirelessly via Bluetooth, and which is decoupled from the robotic-specific architecture which allows Android clients to view, edit, and monitor industrial robotic programming wirelessly via Bluetooth, and which is decoupled from the robotic-specific programming language. The primary benefit of this system is that it would allow a non-expert to adjust the programming of, or interact with, a range of robotic systems using Android-enabled smart phone or tablet device.

A smart phone is a mobile phone built on a mobile computing platform and they are affordable and efficient hand held devices which can be used to support collaborative activities in a community. It is a result of a huge advancement in mobile phones technology. The basic physical architecture for this project is the Bluetooth client/server architecture. An Android enabled device, acting as a client will communicate with a Bluetooth server running on a computer or dedicated controller that has a wired network connection with the robot. Each robot in the environment will have its own Bluetooth server running on its own controller. The computer/controller will not only run a Bluetooth server to communicate with the Android device, but also a socket program that is able to send and receive data from the robots.

II. ANDROID APPLICATION

A. Android SDK

Android is a software stack for mobile devices that includes an operating system, middleware, and key applications. The Android SDK provides the tools and libraries necessary to begin developing applications that run on Android-powered devices.

Android SDK environment for developing GUIs is very suitable for developing the Front end of the application, Android application is a set of Activities pending to each other and each activity has its own UI, the most common way to define a UI is with an XML layout file saved in the application resources. This way, you can maintain the design of your user interface separately from the source code that defines the activity's behavior. The front end of the application is the interface by which users interact with the application.

B. Android Development

Android devices becomes more and more popular for software developers because of its powerful capabilities and open architecture, also it's based on the java programming language. Because Android uses the Java programming language getting started with the Android API is easy; the API is open and allows easy access to the hardware components. Android devices provide numerous communication interfaces like USB, Wi-Fi and Bluetooth, that can be used to connect to the robot. It is a great platform for a robotic system control, because it's much cheaper than any other ARM-based processing unit. Android development is unique in that it completely revolves around "activities." Activities are components of the overall application that provide windows with which a user can interact. An application usually contains several or even many activities that are related to each other. Activities are composed of "views" or graphical user interface components such as buttons and text boxes. These views are called by the activity, usually when it is created. An activity can be called from another activity or it can be designated as the main activity, in which case it is created when the application is initially launched. Each activity has a life cycle. The activity life cycle contains several states including start home activity, resume, pause, stop and command sub activities. Each activity must have each of these states implemented. When an activity calls another activity, it executes the pause state which saves the current state of the activity. If the new activity requires any data from the pausing activity, it must be passed to the new activity when it is called or else the data will be inaccessible. Another way of passing data between activities is by creating a static service that all of the activities can access throughout the lifetime of the application. In the case of a static service, each activity must inherit the necessary functions to fully control the service. Since mobile device and controller has in built memory device this application allows user to get call log i.e. activity performed and the time of that activity can be retrieved.

III.APPLICATION CONNECTIVITY

A. Two-Way Communication

When the application connects to a robot, it starts the Bluetooth service. In order to preserve the Bluetooth services throughout the lifetime of the application, it is necessary to encapsulate them into a container and distribute the container among the activities as needed or else the services would be lost upon pausing or destroying an activity. For each activity to successfully interact with the Bluetooth services, a Bluetooth service handler is required in every activity. The handler monitors whether there has been a state change and what actions need to be taken on such a state change for a particular activity. For example, the different states are "connected," "connecting," "listen," and "none."Based on those states, the handler must determine whether or not an activity can write data, listen for data, or "pop Toast." Popping Toast in Android refers to displaying a temporary dialog on the screen. For example, if the Bluetooth service handler is programmed to pop Toast on connecting to a robot, then a dialog exclaiming "Connected to Robot!" could be displayed on the screen. After an activity determines the current state of the Bluetooth services, it can then determine whether or not it can send data or listen for data. The system is currently configured so that the Android application instigates all communication. Once it sends a message, it changes its state to listening and puts a lock on the service until it receives data back.

Bluetooth: Bluetooth is a wireless communications protocol running at 2.4 GHz, with ISM band, suitable for forming personal area networks. It is designed for low power devices such as mobile phones. Bluetooth now comes as standard on the majority of mobile phones, and desktop computers. It can be easily fitted with a module to allow Bluetooth communication.

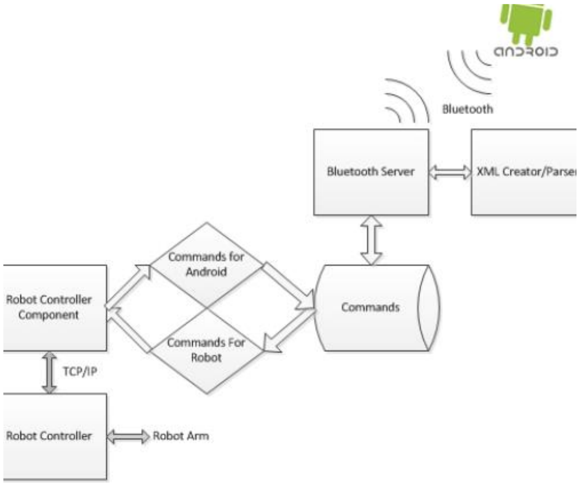

Fig 1. Two-way communication.

This project uses Bluetooth to connect and send direct commands from the mobile phone to control the robot based on direct Commands Communication Protocol. Fig. 1 shows the typical sequence of events when a user runs the application. This sequence diagram assumes the user already has the software on his phone and the robot and it represents an abstract level of the interaction between the system components (mobile application and the robot).

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When the module is at the order-response work mode, user can send the AT command to the module to set the control parameters and sent control order. The work mode of module can be switched by controlling the module input level.

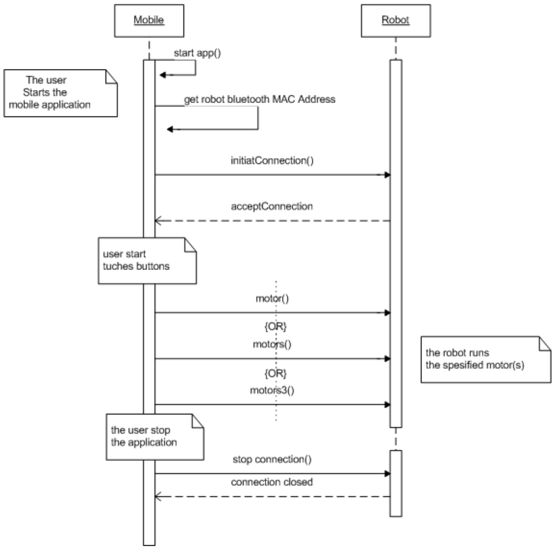
Mobile
Robot
start app()
The user Starts the mobile application
get robot bluetooth MAC Address
initiatConnection()
acceptConnection
user start tuches buttons
motor()
{OR}
motors()
{OR}
motors3()
the robot runs the spesified motor(s)
the user stop the application
stop connection()
connection closed

Fig 2. Communication process sequence

The commands to the Bluetooth modem has to be sent as attention command. These commands are used for initial configuration devices such as baud rate specification, device address and modes of operation. Based on operation, two kinds of modes to be used, they are command mode and bypass mode. On command mode, it is command to locally connected Bluetooth device, while at bypass mode it should be a command to be executed on remotely connected Bluetooth device.

The mobile application consists of many User Interfaces connected to each other, each interface specialized to control a specific functionality on the robot side, each button will send different command to the android client API that will process and execute the command. As shown in Figure 3, the Bluetooth server receives XML data from the Android phone. This data is then sent to the XML Service for parsing and then sent back to the server. The server then evaluates the message type. If the message is a command for the robot, the command is forwarded to the robot controller component and in turn forwarded to the robot controller for execution. If the message is a status update request, then a request is forwarded to the robot controller which sends the update data back to the server which then forwards the data back to the Android phone. The robot controller component maintains a queue of commands received from the phone to forward to the robot. The controller component also keeps a set of time stamped location and program data that is updated regularly, to be forwarded back to the phone upon request.

III.EXPERIMENTAL SETUP

A. 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. 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. 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

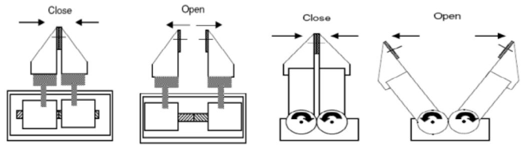

Fig 3: Parallel and Angular Jaw Gripper

B. Hardware setup

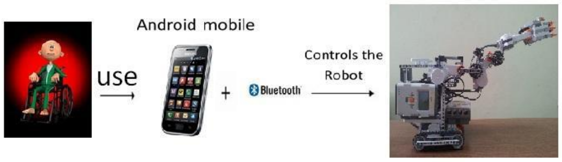

Fig 4- Model Setup

The end robotic arm has 4 joints or junctions, each of which is equipped with dc geared motor. Where the base joint has made to move 360 deg clockwise anticlockwise rotations. Joint 2 & 3 are made to move up & down for 120 deg. The end grippers having spur type gear and used to lift heavy objects. There handheld device can search arm present in its circle of 15meters and can tie-up with one device. Where, each one of the robot having Bluetooth connection through hc 06 module.

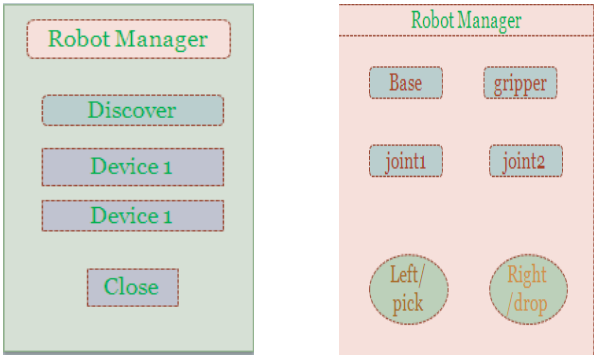

Fig 5- Android Application Layout

For connection establishment Bluetooth device uses AT commands for searching, connecting and for setting transmitting baud rate.

Controller: Micro controller unit controls all functions of robotic arm. Controller is preprogrammed and loaded to work based on the commands, which receives from mobile device through its attached Bluetooth module.

IV. CONCLUSION

This paper has proven that android application and robot controller can involve two-way communication, which would allow non-expert to control and change the functionalities of the robots in industries. In future, instead of giving commands, images of an object can fed as input to the robot to search and find that object inside room and its gripper can be made adjustable to pick any objects, which varies in their shapes. IP Camera attached robot can be given command remotely to remove bombs in defense.

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