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GUI Based Mobile Robot

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***Abstract*— The accuracy of the robot system by using Graphical User Interface (GUI) representation is proposed in this paper, in order to enrich & enhance Robotics. The design of GUI covers its efficiency of working with robot system, and its success which will eventually depend heavily on the quality of its communication interface with the user. Indeed, users will only be able to use its functionality if usability is built into the system. The system is basically developed for tele- operation of robotic arm and the movable platform for sample retrieval and collection. Combination of control functions have been defined and implemented to alleviate the operator's efforts in robotic arm manipulation. The main objective is to deliver a greater understanding of the efficiency & precision related aspects of a Robotic System in internal or external environment.**

***Index Terms*—-Efficiency, GUI, Robot arm, Tele-operation**

I. INTRODUCTION

In major industry fields such as oil production, power plants and health sectors tele- operation is practiced regularly. So a human operator with a precise interface to carry out tasks on remote external environment, the distance between the human operator and remote machine can vary and can stretch as far as another plant. The interface is expected to provide sufficient controls and feedback information to the operator in order to complete the assigned task efficiently, and by adding autonomous features on remote machines like a mechanism. With current technology advances in wireless communication and mobile devices it is beneficial to research the possibility of utilizing those components for tele-operation applications. The objective of this thesis is to design and implement a graphical application on a mobile device to wirelessly tele- operate a mobile robot. The GUI plots the replica of the whole assembly containing mobile platform and manipulator thus helping operator to get the real time view of the robot. This project is DMC based controlled system titled "GUI based mobile robot.

I. SYSTEM DESCRIPTION

Fig.1 illustrates the image of signal flow of the system. The project includes a mobile platform with a robotic arm mounted over it. The application focuses on the movement of the system to a desired location and manipulation of the robotic arm to perform a certain task using tele-operation. The user commands the robot using programming which sets the motion controller on the robot side to work. The motion controller is responsible for the movement of motors and at the same time it gets feedback from the encoders. Thereafter using the kinematical equations the computation of position of the end-effector from specified values for the joint parameters can be made. This computed feedback is sent at the GUI station. A camera is also mounted on top of the mobile platform to increase the situational awareness of mobile robot. The application interface is able to perform the following tasks in real time:

- Connect and disconnect to/from the remote robot.
- Display the robots environment map and plot its locations.
- Move the robot in four directions forward, backward, left and right.
- Display robot feedback information.
- Request and display an image from the robots mounted camera.

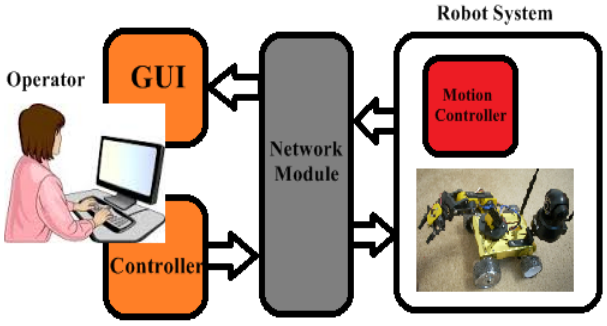

Fig.1. The image of developing model

A. Mobile Robot

A mobile robot is a machine that has the ability to move within an environment and can perform certain operations to accomplish a specific task. The metallic base is equipped with four wheels. These four wheels are connected to four different motors i.e. one motor for one wheel the four wheels individually steerable. This is achieved by connecting a single motor to each motor-wheel assembly.

Fig.2. Mobile platform

B. Manipulator

Manipulator is nothing but a robotic arm with a gripper as its end-effector. it is an 'Articulated' type of robotic arm. An articulated robot is one which uses rotary joints to access its work space. The joints are grouped in a "chain".End effector is having a gripper which can grab and release any object.

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Fig.3. Manipulator

C. Motion controller

It is Designed to solve complex motion problems, the DMC-40x0 can be used for applications involving jogging, point-to-point positioning, vector positioning, electronic gearing, multiple move sequences, and contouring. The controller eliminates jerk by programmable acceleration and deceleration with profile smoothing. For smooth following of complex contours, the DMC-40x0 provides continuous vector feed of an infinite number of linear and arc segments[3].

Features:-

1) Onboard Microcontroller
2) Onboard Motor Driver
3) Onboard Amplifiers.
4) Can Drive 8 motors simultaneously

Fig.4. Motion Controller

D. Camera System

The main features of kinect are:

a) Camera:-It is an ordinary camera which provides the 2D RGB image of any object.

b) Depth Sensor:-It consists of an infrared laser projector which calculates the depth of any object.

c) Multi-array Microphone:-It is basically used for the recognition of voice.

d) Tilt:-The whole assembly is connected to a motor so that we can tilt the kinect to have the visual view from different direction. So the kinect uses the combination of all 4 different parts to give the realistic view of any scene[2].

Fig.5.Camera system

III. NETWORK MODULE

The network module used here is the Wi-Fi router. This network links the flow control, thus giving us the real time feedback, To increase the range of communication repeaters are located at various position

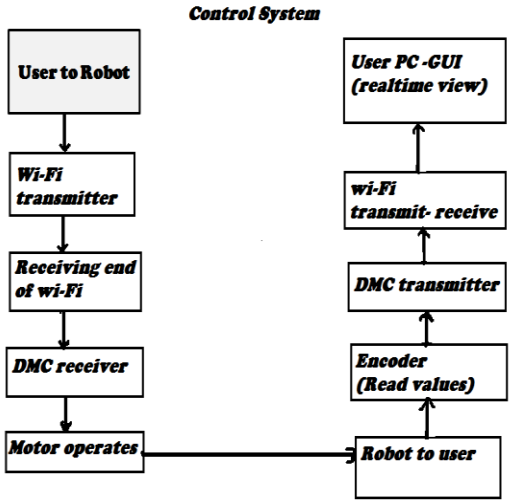

Fig.6 The control system

The operator will command the robot through the controller then these command signals are transmitted over Wi-Fi network to the remote location of the robot. The received commands are processed by the motion controller then depending upon the commands the robot will move in the external environment as the robot assembly moves the encoder connected to the moving parts collect the information and gives this information as a feedback to the Graphical User interface through the motion controller and the wifi network .Thus the GUI plots the exact replica of the robot on the screen of the user so depending upon the feedback plotted the user can take the further decision as how to move the assembly if there are any obstacle in then from GUI we can come to know it and thus operator can take accurate decision such as to move the robot assembly in the reverse direction so that it can avoid the obstacle and move ahead. The robotic

arm i.e. manipulator mounted over the mobile platform where controlling operator's command actions correspond directly to actions in the device.is also plotted on GUI. The mobile platform offers unlimited workspace to the manipulator.

IV. SOFTWARE REQUIREMENT

A. Graphical User Interface (GUI)

GUI is a type of interface that allows users to interact with electronic devices through graphical icons and visual indicators. Tools through which we can interact with GUI are Computer keyboard, mouse, pointing stick, touchpad, trackball, joystick, virtual keyboard, head-up display[4]. Designing the visual composition and temporal behaviour of a GUI is an important part of software application programming in the area of human-computer interaction. Its goal is to enhance the efficiency and ease of use for the underlying logical design of a stored program, a design discipline known as usability.
The GUI gives the 3D view of the object and can be viewed from any viewing angle. After collecting the feedback from the robot, GUI is used to update the orientation and position of the robot . Thus from the changing position of the robot a decision can be taken by the operator as how to move the assembly further. For making the GUI of robot we have made use of programming in C++ and C # languages in graphic based software i.e. visual basics 2010 version with the OpenGL library.

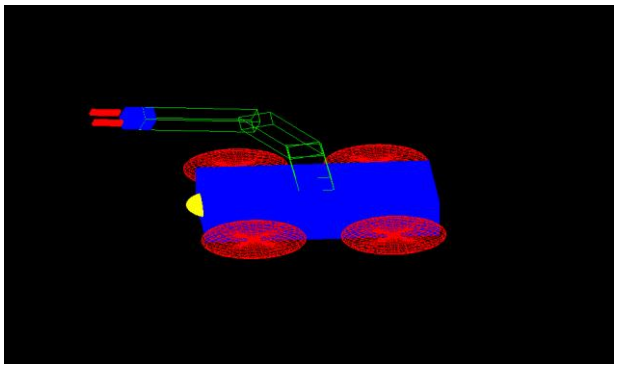

Fig.7.GUI of robot

Host Programming: Here individual Galil's DMC commands are sent from a host computer to the controller's communication bus (Ethernet, RS-232, USB, PCI, etc.). The host could be a computer running Windows, Linux, QNX or it could be an embedded device such as a touch screen. This method is often used when many devices (motion controller, barcode scanner, vision system, etc.) must be coordinated by a host.

B. Application programming interface (API)

In computer programming, an application programming interface (API) is a set of routines, protocols, and tools for building software applications. In addition to accessing databases or computer hardware, such as hard disk drives or video cards, an API can ease the work of programming GUI components. APIs often come in the form of a library that includes specifications for routines, data structures, object classes, and variables.

C. Advanced Robotics Networking Infrastructure (ARIA)

ArNetworking is an extensible networking protocol and infrastructure. It is used to add networking services to a robot control program, integrated with ARIA and other Mobile Robots software libraries. It is used to set up a client-server architecture. A client issues request to a server to issue a single command the server, or to start retrieving data from the server at a specified time interval. A request type is identified by a short string. A client may be an operator's graphical interface, or a component requiring off-board resources. However, a program on board the robot could also implement a client, and issue requests to an off board server.

V. CONCLUSION

Depending upon the feedback received the GUI plots the exact replica of robot the position and orientation of mobile robot and robot arm in real time can be viewed from any viewing angle as well the camera gives the situational awareness of the surrounding environment during day as well as night & the robot can be controlled from a remote location by the user & accurate measurement of various movement is obtained.

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