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Hardware Implementation of Mobile Robot for Tele-Operation

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Abstract—A device which is controlled by a human operator remotely is called a tele-operator. In this paper, the application on system can be developed by the programming Language Java. The implementation of two tele-operation methods is focused here- predefined sequences and instant actions. Data transfer technologies and cellular mobile communications can be used in the robotic system.

Keywords— *Tele-operation; robotics; Mobile robot;*

I. INTRODUCTION

The area of robotics deals with the control of the robots from long distances using wireless connections. Tele-operator is a device which is controlled remotely by a human. Tele-robot is a device which can perform autonomous works. These robots can enter places where it is not possible to enter by humans such as earthquake affected places. This application is developed using the Programming Language called Java. It consists of predefined and instant actions. Merging of robotics with communication mode is the basis of successful robot operation. It is very easy for the user at the receiver side to handle this application. In terms of velocity, range and coverage, this system developed using java platform can give successful results. It helps disabled and mentally challenged people. The working of the robot stresses on the information that we pass to the robot. The mobile robot is helpful in unknown surroundings and not properly oriented areas. The device will contact with the human operator through video communications. It uses the capabilities of a human operator to function well in such surroundings. The robot is far away from the web camera. Care must be taken under such cases where the interference of various hindrances could occur. Force feedback will decrease the stress and possible errors. This also enhances the efficiency of the mobile robot.

With the advancement of technology, the tele-operation has been a major focus of attraction. This is a bilateral process. There is a local site which can control the hand controlled device. In the remote site the robot interacts with the surrounding areas. The communication channel link connects the local site and the rural site. The commands generated by the human operator are fed to the mobile robot in remote site. The communication link gives the various positions of the mobile robot to the human operator. Tele-operation of a mobile robot using bilateral action uses two major types of force feedback. Force feedback is related to information of the various disturbances and obstacles range and it includes information about the state of the robot. A major contribution of tele-robot is in control and the visual applications. A camera can provide a visual view.

Position-speed and position-position command strategies are used for mobile robot tele-operation. A master manipulator's position defines the velocity of the tele-operated mobile robot. In position-speed command strategy robot's position is controlled by position of master device. Hybrid command strategy combines position-speed and position-position strategy. These robots can move in their surroundings. They are not fixed at a single place. They are also used in tightly controlled atmospheres because they have difficulty in responding to unexpected obstacles. They find applications in military and security levels.

For robots used in telecommunication and operations, the internet provides a suitable way. These require local intelligence for dealing with small and restricted bandwidth data. Web browser can help to track a mobile robot and give commands to the robot.

II. BLOCK DIAGRAM

A. Control Section

Mobile robot tele-operation consists of a control unit and a robotic unit. RS232 converter is used for interfacing Personal computer with microcontroller. The converter is used to convert RS232 to Transistor- transistor logic and vice versa. The block diagram of control section is shown in Fig. 1.

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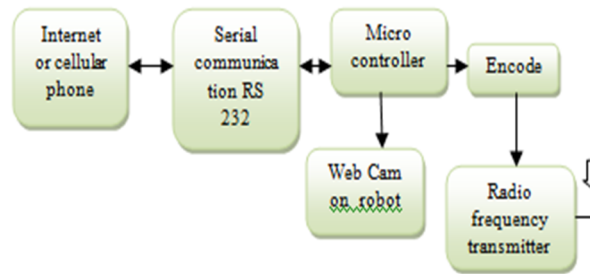


Fig. 1 Block diagram for control section

Receiver is RS232 logic and microcontroller is the Transistor – transistor logic. RS-232 is used for serial binary data communication between data terminal and circuit terminating equipments. A web page is created to give the control commands for the left, right, forward and backward movement of car's wheel. To rotate the stepper motor in the robotic section, a command is given.

B. Robotic Section

The stepper motor's rotation causes the web cam to rotate and will capture images from the desired location. The captured images can be viewed in the PC in the control section. These are used in circumstances which is difficult for humans to be present that is in underwater exploration or in earthquake-damaged buildings. The block diagram of robotic section is shown in Fig. 2.

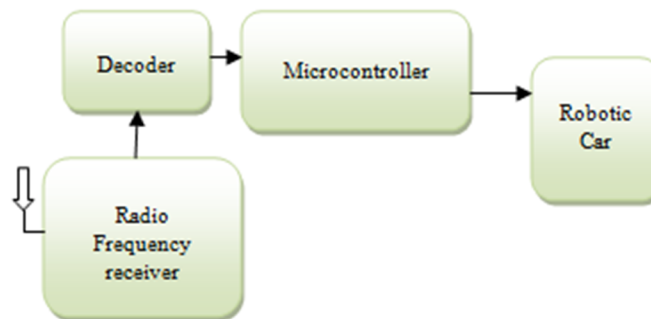


Fig. 2 Block diagram for robotic section

The data is stored in to the server through RS232. Data entered by the control section is then data transmitted through RF transmitter. Transmitted signal is received by the end side and then decoded data is send to the controller. Here the microcontroller uses flash memory which we have already programmed. Controller provides controlling action to robot. Radio Frequency range is from 10 kHz to 300 GHz frequency range which is used for wireless communication. The receiver module RWS-434 also operates at a frequency of 433.92MHz. The Transmitter modules do not have the internal encoding facility. If we want to send signals we have to use an IC set that takes care of various functions. If both modules are in clear vicinity, data is sending to receive module while trying to receive data from transmit module, receiver is heavily loaded. Even though the addresses for both the modules are different it can happen.

III. SYSTEM IMPLEMENTATION

The aim of this car is to help patients suffering from various mental diseases and physical diseases and areas where people cannot enter. The system can be implemented using Java programming language. The shape of the machine is not at most importance but rather the robot should move in 360 degrees. It must be capable of replying and executing commands that originate from a phone. The whole system was incorporated in a car shaped model. The system consists of the power supply module, control and robotic section. Fig. 3 shows the circuit diagram for 5v power supply and Fig. 4 shows the circuit diagram for 12v power supply.

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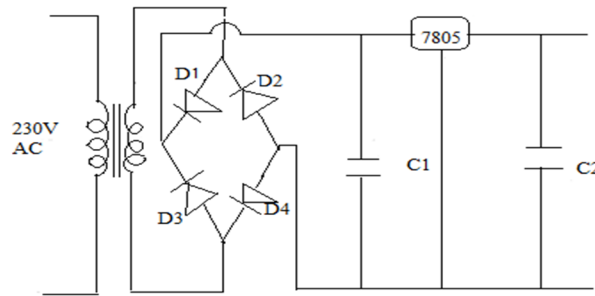


Fig. 3 Circuit diagram for 5V power supply

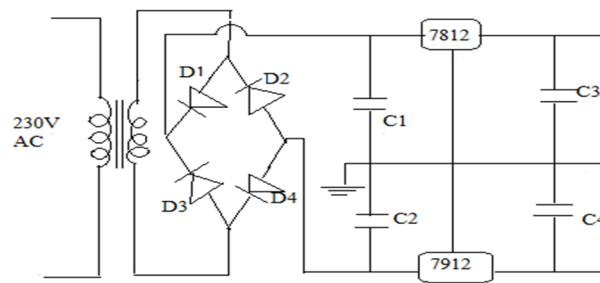


Fig.4 Circuit diagram for 12V power supply

Here a 5V regulated output is generated by passing the 230V ac through a bridge rectifier circuit. This output contains some ripples which are regulated by using a 7805 regulator IC. Hence a constant 5V supply is obtained. The 12V power supply is a battery which is used for the rotation of dc motors. The AT89S51 is a low-power microcontroller. It is a CMOS 8-bit microcontroller. It has high performance. It has 4Kb of flash memory which is in system programmable. It can be reprogrammed. The on chip Flash provides support for this. The AT89S51 provides 4K bytes of Flash. It provides a most flexible and economical solution to various embedded related applications. RAM is 128 bits. It has 32 input output lines. The circuit diagram for control section showing stepper motor part is shown in Fig. 5.

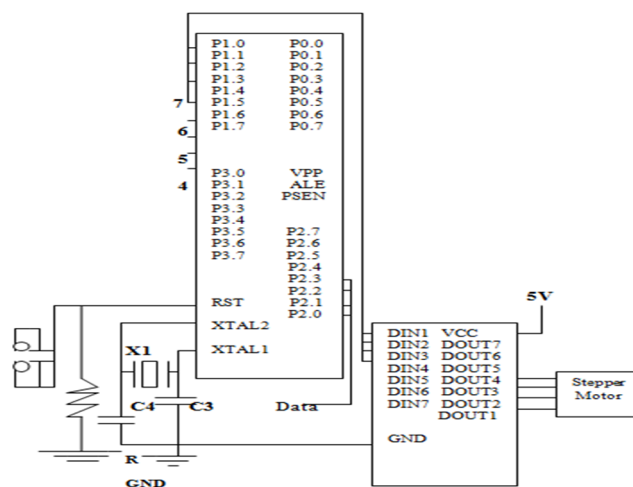


Fig. 5 Part of Circuit diagram of control section

There is a 16 bit counter. It supports two data pointers. There is a clock and on chip circuitry. It supports two power saving modes

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which are software selected. It is designed with static logic. It can operate up to zero frequency. CPU gets stopped at idle mode. The Ram data is saved in power down mode. It will disable the various chip functions. Transmitting and receiving of 1 bit data at a time is called as serial communication. Bit is represented by logical one or zero. To convert a stream of one's or zeros to a byte or reverse is done by using a serial port. UART is universal asynchronous transmitter or receiver. It is a chip which is electronic and holds responsible for the above mentioned operation. The negative voltage on the pin at the input side is affected when 1 is send. The positive voltage on the input pin is affected when a 0 is send. It is said to be in a state called mark when no data transfer is occurring. Fig. 6 shows the circuit diagram of control section.

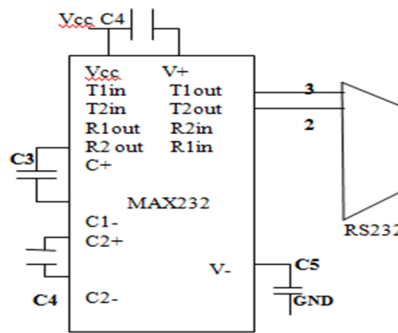


Fig. 6 Circuit Diagram of MAX232

The voltage at the input side pin is negative. When transmitting a byte, the serial port first sends a positive voltage start bit which is followed by the data that is again followed by negative voltage stop bits. The length will be transmitted at the starting which is called as the characteristics. This length varies from five to eight bits. The second characteristic is bit's parity. Third characteristic is defined as the stop bits amount. This value is one or two. This sequence is repeated each time. The HT-12E is the encoder used here. It can encode twelve bits of information and can transmit this data in serial manner. The frequency at which the data is to be send is chosen by oscillator which is connected at outside. The encoder switch which disconnected to the pins can choose the information in ones and zero type to send to the output. Pin-17 the D OUT pin of the HT-12E serially transmits the data on data pins.

The TWS-434 is extremely small and is excellent for applications requiring short-range RF applications. The transmitter operates 433.92MHz. Transmitter accepts both linear and digital inputs and can operate at DC voltages. The receiver also operates at a frequency of about 433.92MHZ. It has both linear and digital outputs. This receiver module does not have the facility of decoding internally. If we want to receive simple signals such we have to use the combined integrated circuit set. The output section uses HT-12D IC. The DATA IN pin-14 of the output reads the zero and one information. Fig. 7 shows the circuit diagram for robotic section.

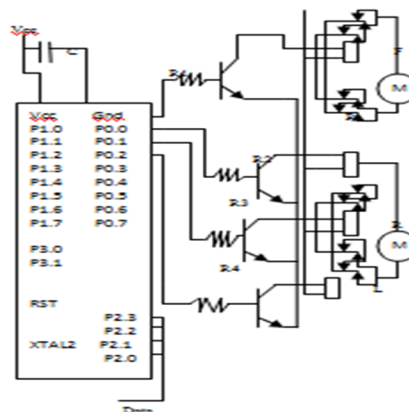


Fig. 7 Part of Circuit diagram of robotic section

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HT-12E and then keeps the data on the output pins. Pins 10 to 13 are the out pins. On receiving a 12-bit word, the initial 8 bits are named as address and the final 4 bits are named as data. Pins numbered from 1 to 8 are the address pins of HT-12E. These pins are used for choosing the address for the two fifty six output side receivers. The address chosen on the HT12E circuit must match the address selected on the HT12D circuit exactly or the data and information will be discarded by the circuit at the output end. The switch used for choosing information on the HT-12E is connected to a microcontroller and one output pin is used to select transmit enable on the HT12E.

IV. APPLICATIONS AND ADVANTAGES

The mobile robot is used for telecommunication. The various applications of these robots are in industries, alarms, security systems. Vending and vehicle machine monitoring also find applications. In medical field, robots are used to help disabled or mentally challenged people. The robots used in telecommunication field find maximum accuracy. They are user friendly. It can perform the domestic level of activities in a semi autonomous manner. The greatest advantage is that they have a vast area cover-up. These robots can be programmed and also reprogrammed from distant locations. They find use in wireless applications. These can increase the performance of robots. They are useful for remote monitoring. High range and mobility can be obtained from these robots. It can be handled very easily and is simple to operate. Manual monitoring should be done using these robots. Distance between units used for observing and robotic section is very less. Some robots will observe people suffering from mental abnormalities. These robots use high power for operation.

V. CONCLUSION

Robotics has now converged with mobile applications and is suitable for the tele-operation of robots. Tele-operation of the robot is the motive of the project. It runs on a Java platform. Java program is written for the tele-operation followed by stepper motor rotation. The application works on a cell phone which implements the robotic and control units. The former consists of the information send by the user while the latter consists of transmitting data's which are already programmed data to the internet. It then sends the data or commands to the robot. It can be designed in a car shape which will work pretty well in all directions and through unmanned tracks.

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