

Controlling and Tracking of Mobile Robot in Real-Time Using Android Platform

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Abstract: The advanced technology as well as capacity of computer growth has offered dynamic opportunity in the advancement of robotic controls and realization of novel techniques of control system. This technological advancement collectively with the need for good performance robots created accurate and faster. This research presented the controlling and tracking of the mobile robot using Video Broadcasting Feature (VBF) and Audio Broadcasting Feature (ABF) for the unknown environment applications. It is an android based autonomous robot with bluetooth and Wi-Fi are used for communication between robot and remote controller. The robot is to be able to move in all four directions which are forward, backward, left and right movements via remote control. This robot is self powered with 9 V supply to power up the microcontroller, motors and transmitter for audio broadcast. Besides that android smart phone is used for video broadcasting with its own battery. The microcontroller used to control the robot remotely is the Arduino, it has built-in input and output ports and other functions. For the real time audio transmitter, it will detect voice and any kind of audio using a mini electric microphone to transmit the signal when detected through a transmitter circuit that is designed to transmit the sound with the specified frequency range. This robot has real-time video broadcasting capability to watch the activities that take place in other places. The real-time video coverage is broadcast by using smart phone that uses broadcasting software called twitcasting. The video is transmitted using internet medium for longer range receiving destination. This mobile robot can be useful in surveillance purpose or military purpose for spying.

Key words: Mobile robot, video broadcasting, audio broadcasting, twitcasting, arduino

INTRODUCTION

In this modern era, technologies have brought a lot of benefits. Human workload has been reduced by computers and robots are used to accomplish specific tasks. Robot is a mechanically and electronically design prototype which is programmed by computers to perform a specific job. Humans have some limitation in performing certain tasks whereas a robot can do the task efficiently without taking many breaks. There are few criteria that a robot must possess, such as a robot should move to one place to another, able to power up itself either with battery, solar power or any other supply, intelligent through programming so that it can perform the assigned task. Many times an army soldier needs to venture into the enemy's base which is part of their activities and is often a very risky job. It may also cost precious lives and while also hazardous. Such a dangerous job could be done by using a mobile robot.

The implementation of obstacle avoidance behavior using an architecture based on fuzzy logic was proposed by Nwe *et al.* (2008). Every behavior contains a set of fuzzy inference module and fuzzy control rules. The output of the obstacle avoidance behavior produces a fuzzy set representing the disallowed turning

directions. The system is pre-limited for going forward, turning right, turning left, going backward and to reach the starting point for no obstacles condition. Then when an obstacle is detected in front, the mobile robot shall halt for a while before turning to the left and check if there are any more obstacles in this turning point. And then it will return to the right and go forward at normal line. For another situation such that when obstacles are detected at the left, the system must turn to right to check if there are any more obstacles in this turning state, then return to left and go straight again at normal line. It will be vice-versa of object on right side of robot. Fuzzy logic, unlike classical logic is tolerant to partial truth, uncertainty and imprecision. In the mobile robot control context, fuzzy logic system based on the control signals can easily transform the advantage of allowing the sensor-based navigation and intuitive nature of linguistic information (Tunstel *et al.*, 1996). Another mapping technique grid based mapping is used by Sebastian Thrun and Bucken. Unlike other mapping techniques, the ultrasonic sensor array itself would not recognize any shape or object so there is no merging of features or landmarks during the mapping process. Instead, it converts all the information gathered into x, y grid and computes the occupancy of that particular grid by passing the data into

a neural network. The value of occupancy will result in the darkness of the corresponding x, y grid means larger value will give darker grid and the result will be integrated over time.

An articulated robotic arm was projected by Delden and Whigham (2012) and the robotic arm can be controlled by an android system in an industry environment. The robotic arm can pick-place and do the industrial works which human's are not able to do. Bluetooth communication connection between the robotic arm and user was also proposed (Delden and Whigham, 2012). The mobile robotic system with mobile device was designed and developed in Kwek. The autonomous robot system tracking using RF was introduced by Sharma and Balamurugan (2015). The wireless communication interfaced between the mobile device and microcontroller was also introduced. The obstacle avoidance was done using IR signals. By using ultrasonic sensor the mobile robot finds the obstacle and detects the obstacle free path using path finder was designed by MacMillan *et al.* (2011). Mobile robot control device that can scan the surrounding environment and sends the data to a server through bluetooth module android platform was also presented by Jenifer *et al.* (2013).

The android application smart device is used to control the mobile robot is presented in this research. Controlling the robot wirelessly through smart device's Bluetooth feature and Wi-Fi is currently done (Velraj Kumar *et al.*, 2010). In this research, the android based phone as a remote control is used to operate the mobile robot. Android is a middleware operating system and key applications for mobile devices. Android has wide variety of connectivity options such as Wi-Fi, bluetooth and wireless data over a cellular connection. Android can be used to build rich applications that offer a wide range of useful tools and libraries. In addition, deep insight and high productivity into the applications android developers provide tools that are built from the ground up alongside the platform includes a complete set. It is ultimately designed to be a low cost wireless networking system for all kinds of mobile devices like Personal Digital Assistants (PDA), smart phones and laptops. Arduino Processor is the main controller for the complete system. Motors, bluetooth device are interfaced with arduino processor. The bluetooth device receives the data from the android based mobile phone is given as the input to the processor. The processor responds accordingly for the movement of mobile robot in all the directions using remote android smart phone.

MATERIALS AND METHODS

A controlling and tracking of the mobile robot can be implemented using android platform. The possible

movements of the designed mobile robot are left, right, forward and backward motions. In addition, for the tracking purpose a smart phone camera is implemented in the mobile robot. The smart phone camera captures the video and send wirelessly to android system. It is implemented for the reason where the humans are not able to perform in the unknown environments such as cave, natural disaster area, underground, etc. On the other hand, this system can also used for military as a spying robot to gather information.

The schematic representation for android mobile robot is shown in Fig. 1. The main component is microcontroller which is the brain of the robot that does the logical and arithmetic process for the robot. The controller that is used in this project is Arduino processor. This microcontroller acts like a small computer that contains electronic components. It runs with ATmega328 in it which contains 14 digital input and output pins also with 6 output pin to control PWM function. Arduino also supports analog input and has its very own 6 input pins with 16MHz ceramic resonators.

Smart phone is used to broadcast live streaming video. It broadcast real time video with twit casting application. It is this broadcasting software that allows it to be used in all type of smart phones. Besides that, it does not require external circuits or wiring to turn on the video broadcasting such as an IP camera or pinhole camera. It can broadcast video from anywhere in the world as long it is connected to the internet. As soon as the user has given the command and the mobile device has sent out the data through bluetooth, the arduino will wait for the data to be received and analyze the data. After analyzing the data, it will do according to what the data had been assigned for. After finishing the task, it will go back to waiting mode. The controller algorithm is shown in Fig. 2.

Figure 3 shows the flowchart for GUI control. As soon as the user give command, the GUI itself will determine the command that the user is giving and send certain data to the arduino through bluetooth. After it finishes sending out the data, it will go back to waiting mode. Integrated Development Environment (IDE) software is used as a programming tool for programming the arduino microcontroller. The programming language that is used to programme an arduino is C or C++ language. IDE has library known to be 'wiring' to enable I/O process faster. User should be able to identify two function which are 'setup()' and 'loop()' as both of this function is important. The 'setup()' function is to initialize the setting once the program starts. As for the 'loop()' function, it is constant until the end and used for repeating the program.

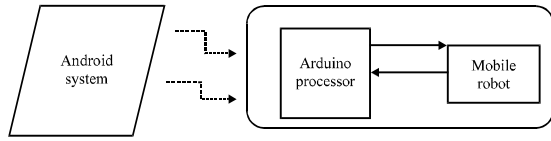


Fig. 1: Schematic representation for android based mobile robot

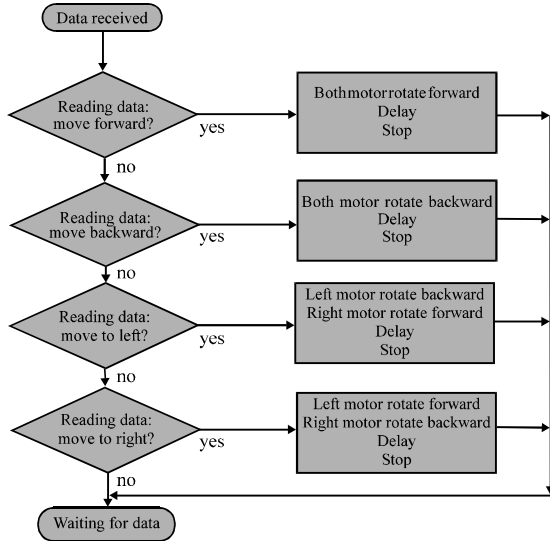


Fig. 2: Flow chart for controller

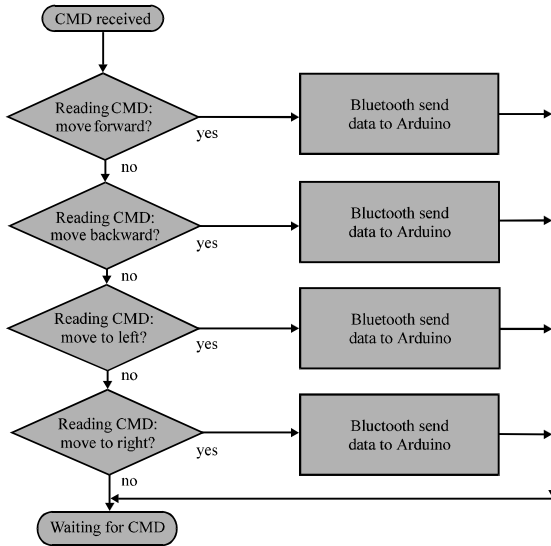


Fig. 3: Algorithm for GUI control

RESULTS AND DISCUSSION

Figure 4 shows the smart device GUI remote control buttons configuration of mobile robot system. The

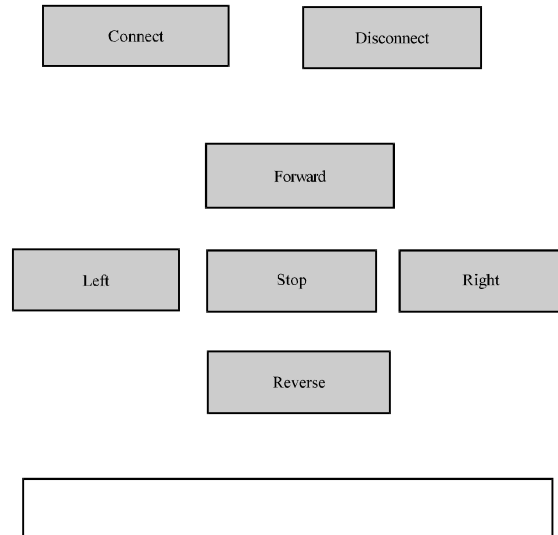


Fig. 4: Smart device GUI control



Fig. 5: Video shots taken

processor will only operate when the port is linked to the processor circuit. Firstly, the Graphical User Interface algorithm checks for the link position of port. If the port is not linked, the error message shows at the status strip as no connection and the whole button to control the mobile robot movement is inactive. If the port is linked, the control buttons are active and the mobile robot carries out the preferred movements.

The remote controller uses five buttons with each as a function to turn left, turn right, move backward, move forward and halt. Button forward-it will send data, to go robot in forward direction. Button backward-it will send data, to go robot in backward direction. Button left-it will send data for the movement of mobile robot to turn left. Button right-it will send data for the movement of mobile robot to turn right. Button stop-It stops the camera. The signal is then sent to microcontroller. The microcontroller which is already pre-programmed with the specified function sends the output signal to the motors. Video is taken during the movement of robot and few frames are shown in Fig. 5.

CONCLUSION

A smart phone based controlling and tracking mobile robot using android application is presented. Using Bluetooth and Wi-Fi the movements of mobile robot are tracked and controlled of position and location by means of the video broadcasting feature and audio broadcasting feature.

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