

Design and Development of Path Following Master and Slave Robot

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ABSTRACT: This project is about the concept of master and slave and it consists of two circuits in which one acts as master and other acts as a slave. We use swarm robotics concept which is a field of multi-robotics in which large number of robots are coordinated in a distributed and decentralized way. It is based on the use of local rules and simple robots compared to the complexity of the task to achieve, and inspired by social insects. This swarm behavior involves constant change of individual in cooperation with others, as well as the behavior of the whole group. In this master circuitry consists of a Bluetooth module controlled by a microcontroller and three IR sensor array is used to follow a path. While performing operations the controller in master circuit transmits the commands to the slave robot by using master slave Bluetooth communication. The slave robot will consist a microcontroller circuit integrated with similar motorized robotic body as the master. It receives the commands send by the master and operates the motors in order to achieve motion as per commands send by the master. Thus, we successfully achieve a master slave communication through the use of swarm robotic concept.

KEYWORDS: Xbee modules, HC-05 bluetooth, XCTU Software.

I. INTRODUCTION

Swarm robotics is a new approach to the coordination of multirobot systems which consist of large numbers of mostly simple physical robots. The desired collective behaviour emerges from the interactions between the robots and interactions of robots with the environment. This approach emerged on the field of artificial swarm intelligence, as well as the biological studies of insects, ants and other fields in nature, where swarm behaviour occurs. Individuals within the group interact by exchanging locally available information such that the problem (global objective) is solved more efficient than it would be done by a single individual. Problem-solving behaviour that emerges from such interactions is called swarm intelligence. Swarm robotics is the application of swarm intelligence techniques to the analysis of activities in which the agents are physical robotic devices that can effect changes in their environments based on intelligent decision-making from various input. The goal of this approach is to study the design of robots such that a desired collective behavior emerges from the inter-robot interactions and the interactions of the robots with the environment, inspired but not limited by the emergent behaviour observed in social insects. The paper is organized in the following manner[1].

II. LITERATURE SURVEY

RA Buckingham and et.al in their paper entitled "Robots in Operating theatres" designed for surgery have three main advantages over humans. They have greater three dimensional spatial accuracy, are more reliable, and can achieve much greater precision. Although few surgical robots are yet in clinical trials one or two have advanced to the stage of seeking approval from the UK's Medical Devices Agency and the US Federal Drug Administration. Safety is a key concern. A robotic device can be designed in an intrinsically safe way by restricting its range of movement to an area where it can do no damage. Furthermore, safety can be increased by making it passive, guided at all times by a surgeon. Nevertheless, some of the most promising developments may come from robots that are active (monitored rather than controlled by the surgeon) and not limited to intrinsically safe motion. Research into the use of robotic technology in operating theatres has reached a critical stage in the United Kingdom and around the world. Many systems that can be described as "robotic" are now working in laboratories, and some are undergoing trials in operating theatres. Although the United States leads in this work, Europe is well placed since the litigious nature of American society makes full

clinical use a risky venture [2]. Bruno Siciliano and et al. in their paper entitled “Control problems in robotics and automation” focused on the important control problems in state-of-the-art robotics and automation, this volume features invited papers from a workshop held at CDC, San Diego, California. As well as looking at current problems, it aims to identify and discuss challenging issues that are yet to be solved but which will be vital to future research directions. The many topics covered include: automatic control, distributed multi-agent control, multirobots, dexterous hands, flexible manipulators, walking robots, free-floating systems, nonholonomic robots, sensor fusion, fuzzy control, virtual reality, visual servoing, and task synchronization. Control Problems in Robotics and Automation will be of interest to all researchers, scientists and graduate students who wish to broaden their knowledge in robotics and automation and prepare themselves to address and resolve the control problems that will be faced in this field as we enter the twenty-first century [3].

III. ROBOT DESIGN

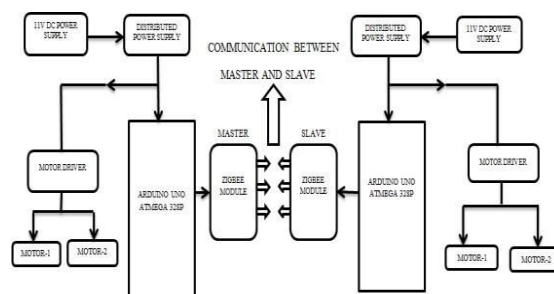


Fig 1: Block diagram of a robot

A. Arduino Uno: Arduino/genuinouno is a microcontroller board based on the atmega328p (datasheet). It has 14 digital input/output pins (6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button). It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino software (IDE) 1.0. The uno board and version of 1.0 Arduino software (IDE) were the reference versions of Arduino, now evolved to newer releases. The uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past, and outdated boards see the Arduino index of boards [4].

Specifications

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

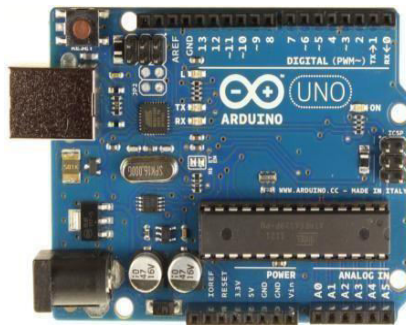


Fig 2: Arduino Uno

B. Zigbee: Zigbee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power, wireless sensor networks. The standard takes full advantage of the IEEE 802.15.4 physical radio specification and operates in unlicensed bands worldwide at the following frequencies: 2.400–2.484 GHz, 902-928 MHz and 868.0–868.6MHz.

1. The power levels (down from 5v to 3.3v) to power the zigbee module.
2. The communication lines (TX, RX, DIN and DOUT) to the appropriate voltages.

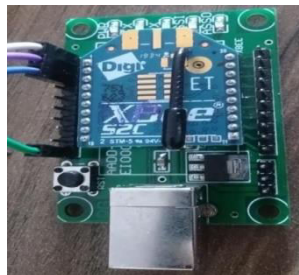


Fig 3: Zigbee

The Zigbee module acts as both transmitter and receiver. The Rx and Tx pins of ZIGBEE are connected to Tx and Rx of 8051 microcontroller respectively. The data's from microcontroller is serially transmitted to Zigbee module via UART port. Then Zigbee transmits the data to another Zigbee. The data's from Zigbee transmitted from DOUT pin. The Zigbee from other side receives the data via Din pin.

ZigBee module. The €1 coin, shown for size reference, is about 23 mm in diameter. ZigBee is a specification for a suite of high level communication protocols using small, low-power digital radios based on the IEEE 802.15.4-2003 standard for wireless personal area networks (WPANs), such as wireless headphones connecting with cell phones via short-range radio. The technology defined by the ZigBee specification is intended to be simpler and less expensive than other WPANs, such as Bluetooth. ZigBee is targeted at radio-frequency (RF) applications that require a low data rate, long battery life, and secure networking.

C. Motor Drive:

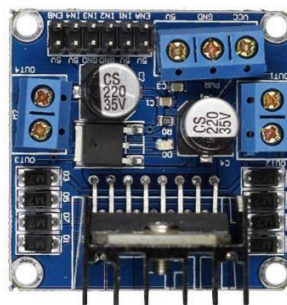


Fig 4: Motor drive

The L298N is an integrated monolithic circuit in a 15-lead Multiwatt and PowerSO20 packages. It is a high voltage, high current dual full-bridge driver e-signed to accept standard TTL logic level and drive inductive loads such as relays, solenoids, DC and stepping motors. Two enable inputs are provided to enable or disable the device independently of the in-put signals. The emitters of the lower transistors of each bridge are connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional Supply input is provided so that the logic works at a lower voltage [5].

D. DC Motors:

A DC motor in simple words is a device that converts direct current (electrical energy) into mechanical energy. It's of vital importance for the industry today.

A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homo-polar motor (which is uncommon), and the ball bearing motor, which is (so far) a novelty.

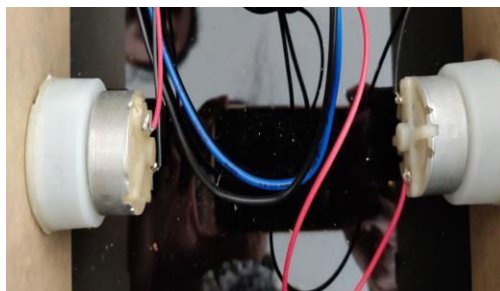


Fig 5 : DC Motors

By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source—so they are not purely DC machines in a strict sense [6].

IV. ROBOT WORKING

Arduino UNO is considered as the heart of the total robot which consist of the microcontroller ATMEGA328P. Path following master and slave robot consists of Arduino Uno, Zigbee, motors, motor driver, battery for power supply and power distribution board for distributing the power supply. To this board, all the remaining hardware components are connected so as to control them.

A battery is connected to the power distribution board as it distributes the power to remaining all the hardware components. Two motor drivers are connected to the different digital (4, 5, 6, 7) pins in the Arduino to control the motors as per the instruction. A Zigbee module which is powered using V_{cc} is connected to digital pins 0, 1 which acts as a transmission and reception pins used to operate the robot in wireless. We give a path to the master robot and it follows the path to the destination and when it gives the same path to the slave as it need to follow the same path at simultaneously. We give commands to the master only and then it sends the commands to the slave. Thus, master and slave reach the same destination while we give commands only to the master.

V. RESULT



Fig 6: Master and Slave robot

In the above figure 6, we are seeing the two robots which one of the master while the other acting as a slave. In the figure the robot which is following the other is called as a slave where the followed robot is called master. Master gave commands to the slave when it is started to the destination and the slave follows the commands to reach the destination.

VI. CONCLUSION

The main aim behind this project is to operate one of the robot without any human commands. It is a new approach to the coordinate of multi robot systems which consist of large number of mostly simply physical robots. Master and slave robots may one day be developed by the thousands of slaves to monitor and sense the environment, inspect machinery, or even perform medical procedures inside the human body.

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