SARCNET Robotics Workshop Plan

Where: Moorabbin and District Radio Club, Opposite 68 Turner Rd Highett, Victoria
When: 6-8pm on Tuesday nights during term
Format: Group discussion and activities followed by individual project work
Website: See www.sarcnet.org/workshops.html for this plan and https://www.sarcnet.org/sarcbot1.html and https://www.sarcnet.org/sarcbot2.html for design notes and software download.

1. Introduction to the Robotics Workshop:
    a. Introducing the SARCBOT/MYBOT Project
        i. SARCBOT is the group's robotics project as documented on this site
        ii. MYBOT is the student's individually tailored version of SARCBOT
        iii. MYBOT hardware is generally kept at the club rooms for safe-keeping
        iv. Prerequisites: A laptop computer, an engineering notebook, Robotics Platform ($33)
        v. Additional robotics hardware can be provided on request at cost prices
    b. Working together as a group through each phase on SARCBOT:
        i. Brainstorming, concept development, system requirements, design decisions
        ii. Designing, experimenting, prototyping, problem solving
        iii. Selecting parts, electronics soldering and mechanical assembly
        iv. Software coding and debugging
        v. Systems integration and testing
        vi. Documenting and uploading everything to this site
    c. Working individually through each phase on MYBOT:
        i. Designing MYBOT
        ii. Building and coding MYBOT
        iii. Demonstrating and evaluating MYBOT
    d. Robot demonstration and evaluation
        i. mBot demonstration
            1. Manual mode
            2. Obstacle-Avoidance mode
            3. Line-Follower mode
            4. Infrared control
            5. Bluetooth control
        ii. Performance evaluation
            1. Speed
            2. Acceleration
            3. Turning circle
            4. Obstacle avoidance
            5. Remote control
        iii. Discussion and brainstorming
        iv. System requirements and design decisions for our SARCBOT/MYBOT
    e. Workshop design and development phases
        i. Phase 1: Robot power and drive subsystems
        ii. Phase 2: Robot sensor subsystems
        iii. Phase 3: Robot actuator subsystems
        iv. Phase 4: Robot control subsystems
        v. Phase 5: Robot communication subsystems
        vi. Phase 6: Robot navigation subsystems
        vii. Phase 7: Robot applications
2. Phase 1: Robot power and drive systems
    a. Electric motors
        i. Motor types: DC motor, stepper motor, servo motor
        ii. Motor connections and characteristics (voltage and current)
        iii. Motor drivers: Relay, Open collector, H-bridge
    b. Motor controls
        i. Motor forward and reverse control

        ii. Motor speed control: Pulse Width Modulation
        iii. Motor controllers: Switches, joysticks
        iv. Motor safety: Start safe, run safe, fail safe
        v. Motor acceleration control: Overdamping, soft start/stop
        vi. Motor synchronization: Photo-interrupters
    c. Electric Batteries
        i. Battery types: Carbon, Alkaline, Lithium, NiCd, NiMH, LiPo, LiFePo4
        ii. Battery safety: Fuses, circuit breakers
        iii. Battery charging
        iv. Battery monitoring
    d. Power supplies
        i. Power distribution
        ii. Voltage regulators
        iii. DC-DC converters
3. Phase 2: Robot sensor subsystems
    a. Voltage, current, resistance, capacitance
    b. Microswitch, touch switch, potentiometer, shaft encoder, proximity switch, line-follower
    c. Thermometer, hygrometer, accelerometer, magnetometer, barometer, anemometer
    d. Vibration, tilt, force, flex, weight, gyroscope
    e. Acoustic, ultrasonic, gas, water, light, colour, UV, ionizing radiation
    f. Camera, LIDAR, Barcode, RFID reader
    g. GPS Receiver, Real Time Clock
    h. RF/IR remote controls
4. Phase 3: Robot actuator subsystems
    a. Motors: Stepper motor, servo motor, DC motor, relay, solenoid
    b. Annunciators: Buzzer, bell, speaker, siren, speech
    c. Displays and indicators: Monochrome, colour, text, graphics, LED, LCD, OLED, Strobe
5. Phase 4: Robot control subsystems
    a. Robot architecture: Functional Block Diagram
    b. Central Processing Unit
    c. Startup and shutdown sequence
    d. Monitoring and control
6. Phase 5: Robot communication subsystems
    a. Internal communications: Digital I/O, Serial I/O, I2C, SPI
    b. External communications: Infrared, RF (OOK), Bluetooth, WiFi, LoRa
    c. Remote control
    d. Telemetry
    e. Video
7. Phase 6: Robot navigation subsystems
    a. Navigation sensors: IR, ultrasonic and laser proximity sensors
    b. Obstacle avoidance
        i. Obstacle detection: Sensors, sensor limitations, sensor fusion
        ii. Obstacle avoidance strategies
    c. Location and orientation
        i. Mapping
            1. Coordinate systems
            2. Bearings
            3. Waypoints
        ii. Navigation
            1. Point Made Good
            2. Track Made Good
        iii. Dead reckoning
    d. Navigation sensors:
        i. Compass
        ii. GPS
    e. Navigation algorithms:
        i. Search patterns

        ii. Return to base
8. Phase 7: Robot applications
    a. Cleaning
    b. Security
    c. Gaming