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Exploring Wiced Sense

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1.1 Abstract

With hundreds of new ideas for applications of wireless devices it is critical that developers are provided a platform to quickly test their concepts and bring them to real use.
This project aims at exploring different aspects of WICED Sense (SIP Module), in order to start experimenting with sensor technology which will enable the developers to include physical quantities such as temperature, atmospheric pressure ,humidity, direction, acceleration, yaw, pitch, roll, etc.
The aspects include understanding the wiced sense sdk in order to program the device for user specific application , procedure to acquire the data from the wiced tag , saving the acquired data in a online database so that it can be accessible for distant users for processing , visualization of the sensor data on website , making automation related applicatons and path mapping of Firebird V robot on a webpage using the sensor data.
The ultimate goal of the project is to create a basic platform inorder to enable future developers exploit the sensors in wiced sense.

1.2 Overview of tasks

- Downloading the SDK for WICED Sense, and getting familiar with it.
- Exploring different methods through which the data from wiced sense can be acquired and selection of one method to use throughout the project, taking into consideration all the aspects of project.
- Pushing the obtained data onto an online database.
- Creating GUI to display the obtained sensor data on the webpage.
- Developing a notification system so as to alert the user of a specific event on the webpage.
- Using the sensor data to perform path mapping of the Firebird V robot.
- Creating tutorials and documentation.

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1.3 Hardware Components

- Wiced Sense SIP Module

Figure 1.1: Wiced Sense

  - WICED Sense is a BLE device manufactured by Broadcom* which can provide wireless connectivity to wide range of embedded applications.
  - The WICED Sense TAG is made up of the BCM20737S Bluetooth Low Energy SoC and five ST Microelectronics sensors: gyroscope, accelerometer, magnetometer , pressure, humidity and temperature. The BCM20737S connects directly to the sensors without the need for an external microprocessor.(* 5 July,2016 onwards Broadcoms IoT business is acquired by Cypress.)
  - ST Microelectronics Devices used in the WICED Smart Kit:
    * Gyroscope (L3GD20)
    * Accelerometer (LIS3DSH)
    * Magnetometer (LSM303D)
    * Pressure sensor (LPS25H)
    * Humidity and Temperature sensor (HTS221)

Wiced Sense Vendor Link
Wiced Sense Introduction

Figure 1.2: Xbee Module

- Xbee Module
  - XBee is the brand name of a family of form factor compatible radio modules from Digi International. The first XBee radios were introduced under the MaxStream brand in 2005 and were based on the IEEE 802.15.4-2003 standard designed for point-to-point and star communications at over-the-air baud rates of 250 kbit/s.
  - The XBee radios can all be used with the minimum number of connections power (3.3 V), ground, data in and data out (UART), with other recommended lines being Reset and Sleep. Additionally, most XBee families have some other flow control, input/output (I/O), analog-to-digital converter (A/D) and indicator lines built in. A version called the programmable XBee has an additional on-board processor for users code. The programmable XBee and a surface-mount version of the XBee radios were both introduced in 2010.
  - We are using XB24-AWI- module.
- Firebird V (Atmega 2560)

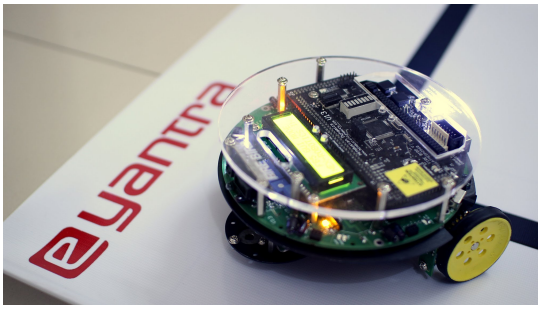

Figure 1.3: Firebird V Robot

1.4 Software Components

- Linux Environment
  - Node Js

Figure 1.4: Node JS logo

    - Node.js is a platform built on Chrome's JavaScript runtime for easily building fast and scalable network applications. Node.js uses an event-driven, non-blocking I/O model that makes it efficient, perfect for data-intensive real-time applications that run across distributed devices.
  - Cylon Js

Figure 1.5: Cylon JS logo

    - Cylon.js is a JavaScript framework for robotics, physical computing, and the Internet of Things. It makes it incredibly easy to command robots and devices.
    - Cylon.js has an extensible system for connecting to hardware devices. Compatiblity of the hardware can be found at https://cylonjs.com/
    - Cylon js supports wiced sense. It has support to BLE (Bluetooth Low Energy) devices.
- Installation Procedure for the softwares.

- Windows Environment
  - Wiced Sense SDK

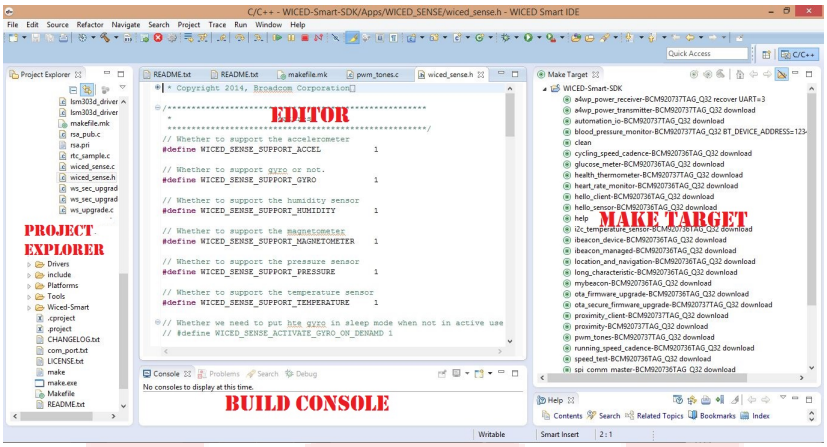

Figure 1.6: Wiced SDK

It is used to program the Wiced Sense Kit.

  - Atmel Studio

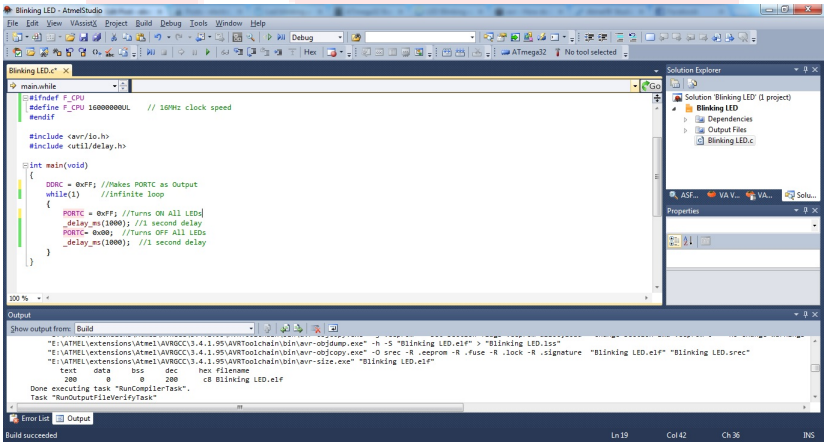

Figure 1.7: Atmel Studio

It is used to program Firebird V robot.

– AVR Bootloader

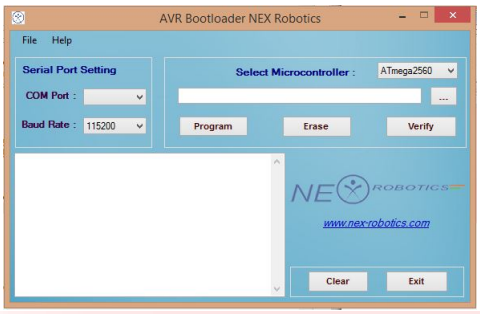

Figure 1.8: AVR bootloader

It is used to burn code into Firebird V.

– XCTU

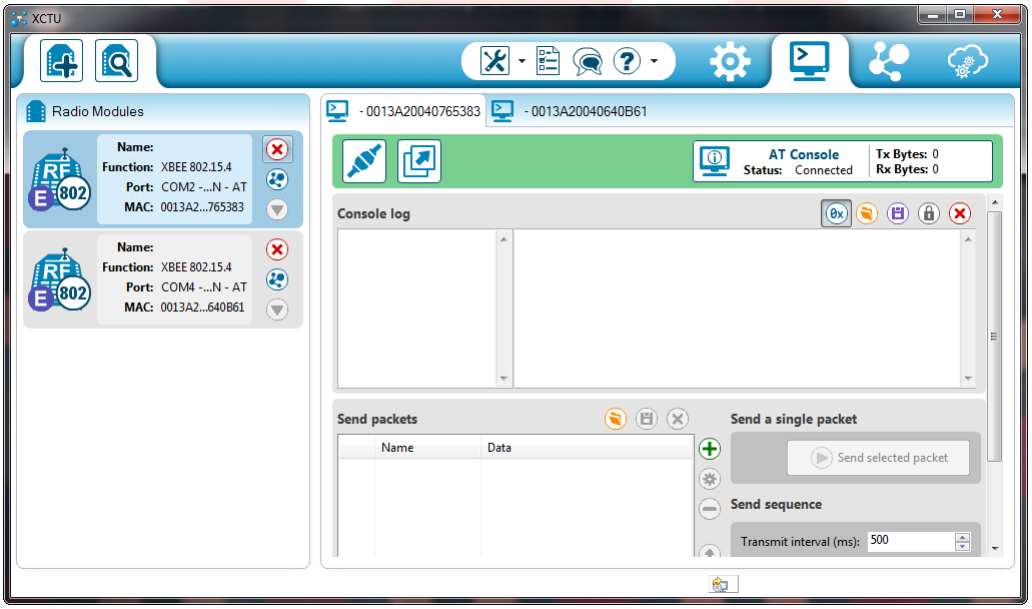

Figure 1.9: XCTU

It is used to configure Xbee Module.

1.5 Data Flowchart

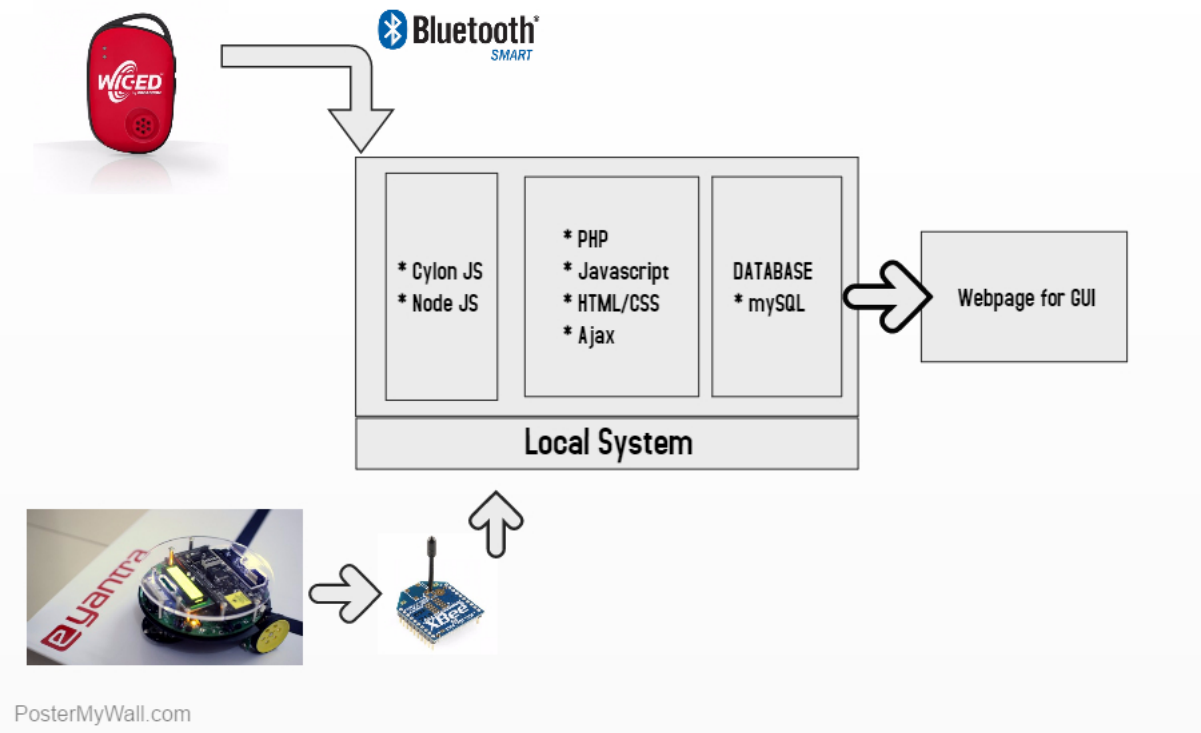

Figure 1.10: Data Flow Diagram

- Figure 1.10 represents the data flow diagram in our project.
- Wiced Sense is a BLE (Bluetooth Low Energy) device. It sends the data through Bluetooth to our local system, in our case ubuntu. We need to make sure that our system is BLE compatible.
- All the sensor data whose default packet format is explained in Wiced Data Format is sent to the local system in hex format.
- The data is taken into local system with the help of cylon-wiced-sense module. The working of the system can be understood constructively with the help of codes. The following link diverts the document to a github link where one can download the codes related to this project and analyse it. wiced-sense.js driver.js

- Firebird is coded to follow the white line and send the distance travelled by the robot to the local system using Xbee. Distance travelled by the robot is given by the wheel encoders. The link to the code is given here
- The data of both the wheel encoders are sent.
- The node package serialport(which has to be installed in system) is used to communicate between Firebird V and local machine via XBee.(As Xbee is connected on serialport).
- Combination of wiced data and encoder data is used for robot mapping which is explained later in the report.
- All the data recieved is then parsed and sent to php code using a node module querystring.
- It uses POST method to send data via URL to PHP.
- The PHP code whose link is provided here takes the data from URL and updates the tables in the SQL database using SQL query.
- Now the current webpage calls a PHP page asymmetrically at the server which gets the latest updated data from mySQL database and pass it to webpage via ajax. The link to php code is given here
- The data recieved on webpage is used for changing the GUI dynamically. The algorithms are created and the coding of calculations is done in javascript.
- The webpage for each application is different and is explained further.

1.6 Database Structure

- MySQL is used as database.
- Database name is "wiced".
- Database contains table named as "data".
- The table "data" has 1 row which contains 17 columns.
- Data from cylon code (wiced-sense.js) is being inserted in these columns.
- Data is being continiously updated in these columns.
- Column structure
  - Column 1 : id
  - Column 2 : one (aAcelerometer X axis readings)
  - Column 3 : two (Accelerometer Y axis readings)
  - Column 4: three (Accelerometer Z axis readings)
  - Column 5 : four (Gyroscope X axis readings)
  - Column 6 : five (Gyroscope Y axis readings)
  - Column 7 : six (Gyroscope Z axis readings)
  - Column 8 : seven (Magnetometer X axis readings)
  - Column 9 : eight (Magnetometer Y axis readings)
  - Column 10 : nine (Magnetometer Z axis readings)
  - Column 11 : ten (Humidity readings)
  - Column 12 : eleven (Pressure readings)
  - Column 13 : twelve (Temperature readings)
  - Column 14 : thirteen (Set temperature data)
  - Column 15 : EncoderL (Robot left encoder reading)
  - Column 16 : EncoderR (Robot right encoder reading)
  - Column 17 : reg-date (Timestamp)

1.7 Webpage Description

1.7.1 Sensor GUI page

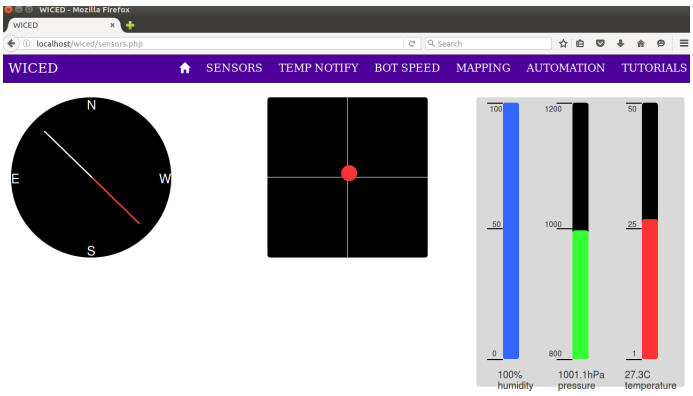

Figure 1.11: Sensor GUI

We have made this GUI inorder to display the sensor readings in an interactive and simpler form.
As seen in the image GUI consists of a compass , whose needle's direction is changed according to rotation of the wiced tag with respect to earth's north pole.
The Bubble level indicated the accelerometer readings. The bubble level shifts according to the acceleration in particular direction.
The 3 bars at the right of the page display the current temperature , pressure and humidity.

Code Description

- GUI for this page is made using CSS and HTML.
- This page continuously makes a request to new.php page at server for every 10ms using an AJAX call.
- new.php page extracts all sensor data from mySQL tables using query and returns the extracted data to the sensor page after converting it into JASON format.
- This json format is parsed and all the sensor data are calculated separately to plot or change the gui dynamically.
- The link for the code is given here

1.7.2 Temperature notifier page

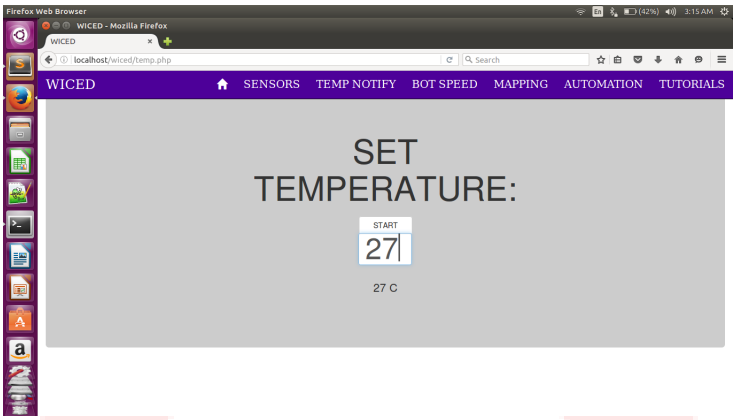

Figure 1.12: Temperature Notifier page

This page allows the user to set a particular temperature to trigger a event. The user sets the temperature by entering the temperature in the text box and hits start. Then this value is set as a threshold and a pop up appears if the temperature exceeds the limit.

Code Description

- GUI for this page is made using CSS and HTML.
- This page sets the threshold temperature via HTML form and submit it to test.php
- test.php updates the threshold temperature value to mySQL database.
- This page continuously (10ms) makes a request to new.php page at server using an AJAX call.
- new.php page extracts temperature sensor data from mySQL tables using query and returns the extracted data to the temperature page after converting it into JASON format.
- Jason value of the sensor data is parsed and temp sensor data is calculated and compared with fixed/selected threshold temperature value
- As soon as the current temperature goes above fixed temperature, a popup alarm is raised using javascript alert.
- The link for the code is given here

1.7.3 Bot mapping page

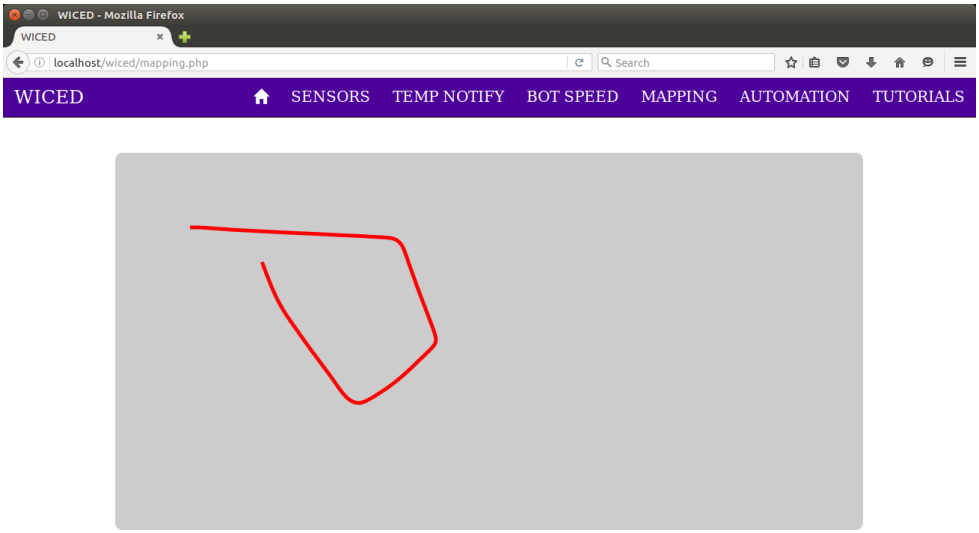

Figure 1.13: Robot Mapping Page

This page provides a visualization of the real time movement of the robot. It uses SVG (Scalable Vector Graphics) to draw the map. The path of the bot is traced on the screen as the bot proceeds.It uses data from the magnetometer to determine the angle of rotation and the value of encoder to give the distance travelled so as to facilitate path mapping.

Code Description

- GUI for this page is made using CSS and HTML.
- This page continuously makes a request to new.php page at server every 10ms using an AJAX call.
- new.php page extracts the sensor data of magnetometer and encoder of bot from mySQL tables using query and returns the extracted data to the mapping page after converting it into JASON format.
- This json format is parsed and all the sensor data are calculated separately to plot or change the gui dynamically.
- Magnetometer and Encoder readings are used to achieve bot path mapping using HTML SVG's
- The link for the code is given here

1.8 Future Work

- Large Scale Purpose
  - As the wiced contains accelerometer, gyroscope and magnetometer, it can be used for 3D mapping of an areana.
  - The wiced sense has a total 5 sensors, so this tag can be used to create IOT applications
- Small Scale purpose
  - Wiced Sense can be used as smart tags that can be attached to objects which are likely not to be found while in a hurry eg.keychain
  - It can be used to replicate the drawings made on the floor on the computer screen for further processing.

1.9 Bug report and Challenges

- Bugs
  1. Sometimes their is connection loss between wiced tag and PC (mostly the case of low battery)
  2. During mapping sometimes the point deviates from orignal position
- Challenges Faced
  1. Installing all the modules in cylon js and node js.
  2. Sending data from cylon code to mySQL database.
  3. Path mapping of firebird robot on webpage
- Work Halfdone
  1. Calculating velocity using wiced sense.

1.10 Conclusion

This project aimed at exploring the wiced sense module so as to create various applications using the features it possess. The tasks which we done created a platform by making the data from the wiced sense available on the network which inturn can be used to develop many applications.
Some of the applications we done were displaying the sensor data on web, creating a notification system and mapping the robot movements on a webpage.

Bibliography

[1] SVG Tutorial, *SVG path, SVG line, Stroke* Website link

[2] JavaScript Math Reference, *math.abs, math.ceil , math.round , math.atan2* Website link

[3] Node js, *querystring, serialport* Website link