**IDA on Lab on Wheels - Wearables Lesson Plan/Facilitator Guide**

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*Prepared by EWB-Asia*

LESSON GOALS

1) Experiential learning

2) Data collection and analysis

3) Critical thinking

MATERIALS REQUIRED

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| Station materials | Components |
| Wearable given to each student | U8 Smart watch |
| Lesson Material for each group | 1) Main module  2) Sensors modules: magnetometer, gyroscope and barometer  3) Bluetooth transmission module |

PROCEDURE

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| Item | Suggested Time | Learning points |
| Background  Introduction  Explanation |  | 1) Introduction to wearables  - Applications:  ● Wearables are most commonly used in sports and fitness – for purposes of monitoring heart rate, distance covered (pedometer), running speed, calories burnt etc.  ● In professional sports, wearable technology in the form of inertial sensors are used to monitor the performance of athletes  ● Wearables also have widespread application in the healthcare sector, for example in measuring vital health statistics and indicators of patients.  ● Increasingly, wearables can function as tracking devices (GPS function) – from monitoring the whereabouts of elderly and the disabled to enabling caretakers to monitor dementia patients from remote locations  ● Less commonly seen are applications in smart homes e.g. controlling light switches using wearables.  - Forms: Watches, smart jackets, chest strap for heart rate monitoring, smart socks with impact sensors  2) Explaining wearable technology  - Main features of wearables are  ●        Sensors for inputs (pressure, temperature, accelerometer etc.)  ●        Capability to communicate with other devices to transmit data  - Analog to Digital sensors  Magnetometer - detect the strength and direction of an incident  Gyroscope – Digital-output X-, Y-, and Z-Axis angular rate sensors (gyros) on one integrated circuit  Barometer – senses change in pressure |
| Experiential learning & Critical thinking  *Proposed Activity* |  | Competition to reach the highest point in the bus  - Instruct students to put on a wearable each  - Get them to swipe to the altitude app and start the app.  - Explain the significance of setting the datum at the current altitude above sea level (press set height)  - Subsequent relative changes from the datum will be used as judging criteria  - Record each student’s change in height on shared spreadsheet  - Student who can get the highest relative change in height wins  Critical thinking  - Question: Why are the readings not accurate  - Answer: Barometer which measures changes in pressure, hence change in altitude, is highly sensitive to movement and external factors. Any external factors which affect pressure will cause the readings to fluctuate e.g. air conditioning draughts, breathing directly on the wearable, fanning of arms causing air pressure changes. |
| Experiential learning and Data collection  *Proposed Activity* |  | Competition to maintain the main module level in 2 different positions  Objective: This activity will show them how the components inside the wearable look and work – to show students a “blown up wearable”.  Setup (one setup per station per computer):  1) PCB board with sensors - students will be required to assemble the sensors onto the PCB board (schematics to be provided near end of Feb).  2) PCB board will be pre-mounted onto a supporting plate with 5 handle fixtures. The handle fixtures are for each student to collaboratively support the assembly.  3) A bluetooth chip connected to the main module will enable the assembly to communicate wirelessly with each computer at each station. Readings from the assembly will be recorded and can be viewed on the user interface (UI) programmed on each computer. This will be the main judging tool for this competition.  Pre-activity explanation:  - Instruct the students to assemble and attach the sensors provided (magnetometer, gyroscope and barometer) onto the main module.  - Explain the purpose of each sensor and how each sensor’s readings are transmitted and displayed onto the UI on the computer via the bluetooth chip.  - Explain and demonstrate how moving the assembly will translate to a reading on the UI display - specifically:             Magnetometer: turning the assembly to face a different direction should produce changes in the compass readings.  ●    Gyroscope: rotating the assembly (in roll pitch or yaw) should produce changes in rotational xyz axis readings  Barometer: shifting the assembly up and down should produce changes in relative height readings (due to changes in pressure)    Activity:  - Each group will be required to maintain the assembly in one static position and one dynamic action. This is to be done with all group members holding onto one handle each. The judging criteria will be the roll pitch and yaw degrees recorded on the UI.   1. Static position: Keep the assembled components perfectly horizontal for a stipulated timeframe. 0 readings on rotational xyz axis for the longest time. 2. Dynamic Action: Keep the assembled components in rolling motion at 15 rpm (2 seconds for a 180 degree motion) for the longest time frame.   Critical thinking  - Questions  1) Recap on the functions of the sensors (which sensor measures level/altitude? etc.)  2) How easy was it to keep the board level and stationary with all group members holding onto it? Imagine if you were flying a plane, there will be many forces acting on a plane in flight, explain how sensors can help maintain level flight?  3) For a professional athlete, how would monitoring his performance help him win the race? For a disabled or elderly person, how would monitoring his vitals help them in their daily lives? Which sensors would be most useful to each group of people?  4) How sensitive / accurate were the sensors?  5) Suggest other possible uses for these sensors on a wearable |
| Conclusion and take away points |  | Summarize applications by asking questions on the following salient points:  1) Wearables can be used in daily life by anyone to keep track of their health and activity  2) Can be used by disadvantaged groups as tracking devices |