Open source health monitoring and evaluation systems using python

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Introduction

What are Health monitoring systems:

- Various sensors monitor health parameters
- Sensors are integrated with processing and memory units
- Data is analyzed: online and offline mode
- Data reflects status of subject's health

Why Open Source

- Reduce cost
- Induce innovation
- Faster development processes
- Universal access to quality health

Sensors

- Sensitivity
- Accuracy
- Precision

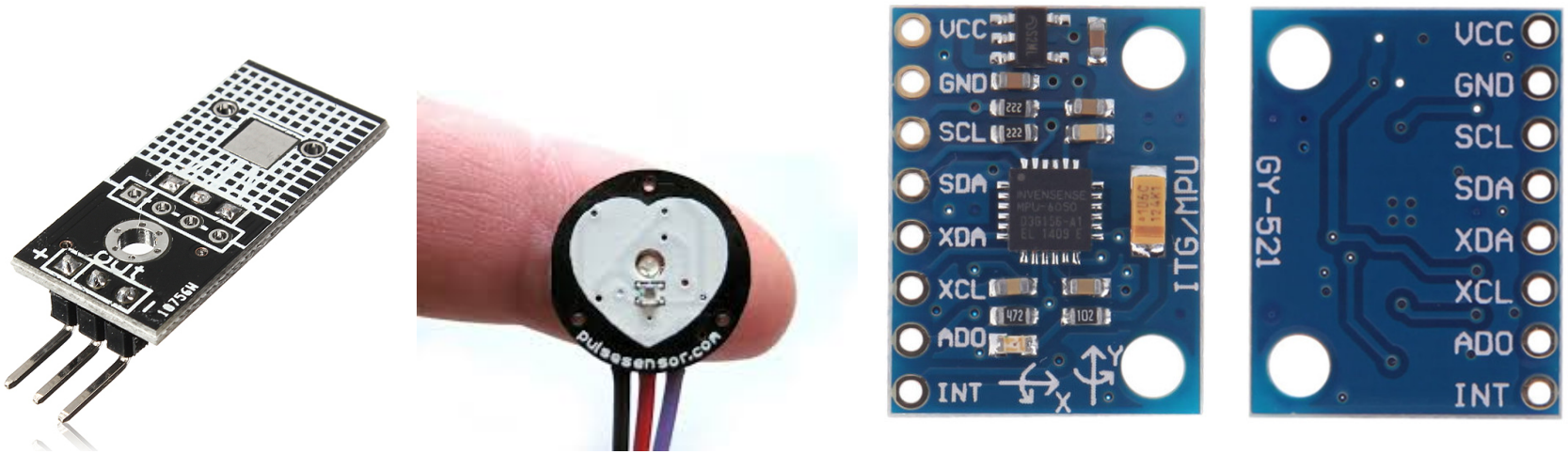


Figure: Gyrometer sensor, Pulse Sensor and Arduino Uno

Experiments

Two proposed experiments:

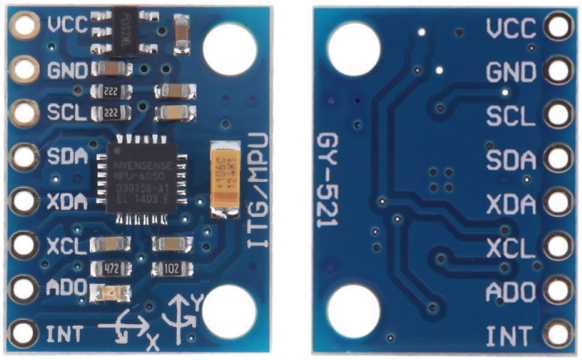
- Classifying runners
- Analysing sleeping pattern for elderly patients

Ex-1: Classifying runners

- Problem statement
  - Runners run differently but are evaluated on similar parameters
  - We aim to classify running patterns and accordingly evaluate the runners for thier type of running

Hardware

- Sensors: Accelerometer and Gyrometer (single unit)
- Platform: Arduino Uno
- For data analytics: Python



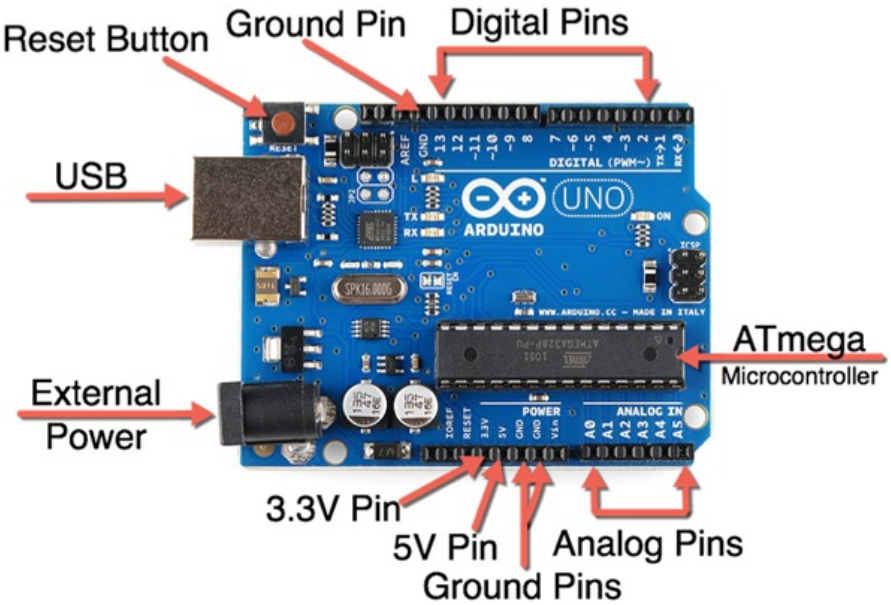


Figure: GY-521 Gyrometer module and Arduino Uno Microprocessor

Electronic schematics for hardware

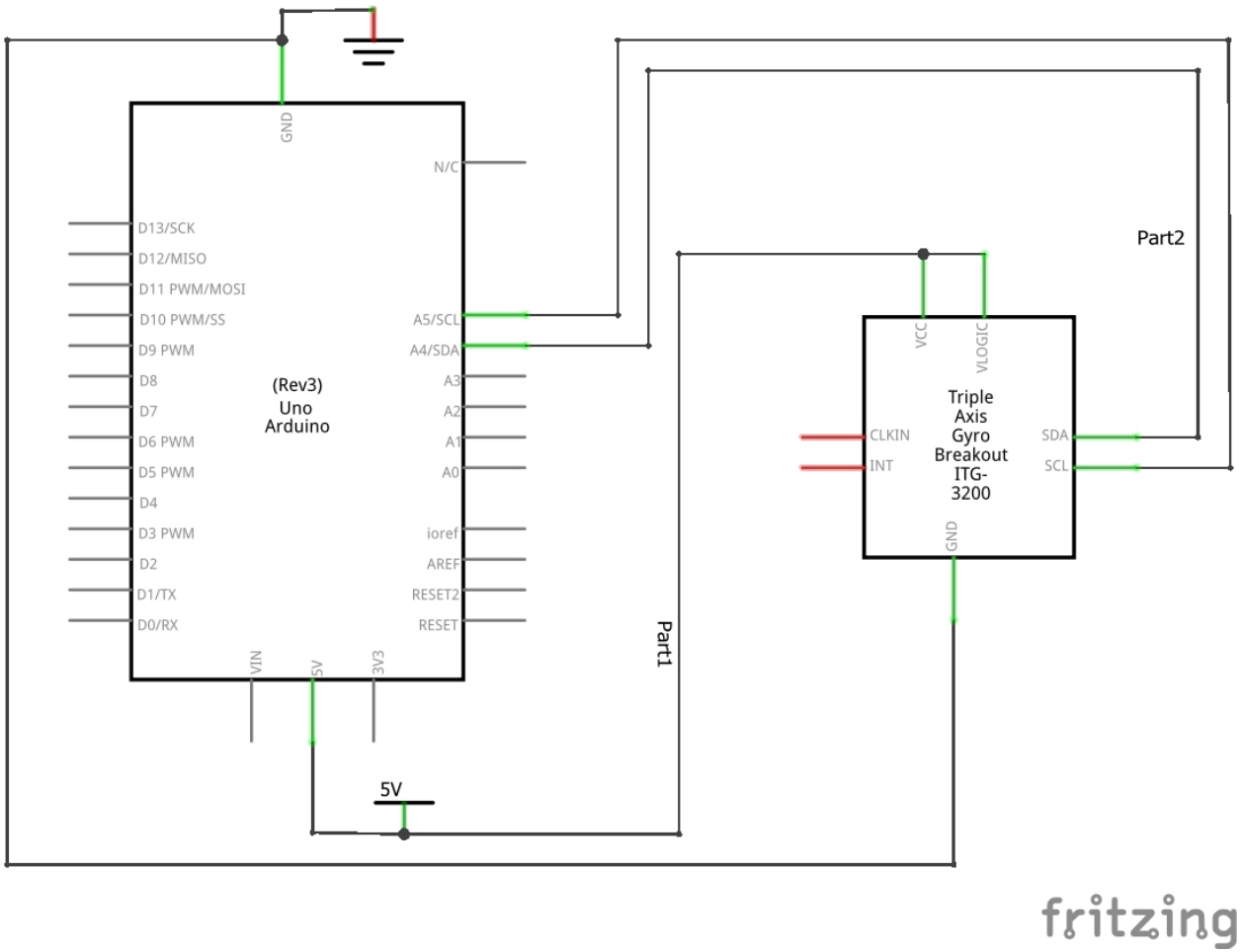


Figure: Connecting gyro-accelerometer unit with Arduino Uno

Code

- Github link: `https://github.com/R-A-M-A-N/Arduino-Codes`

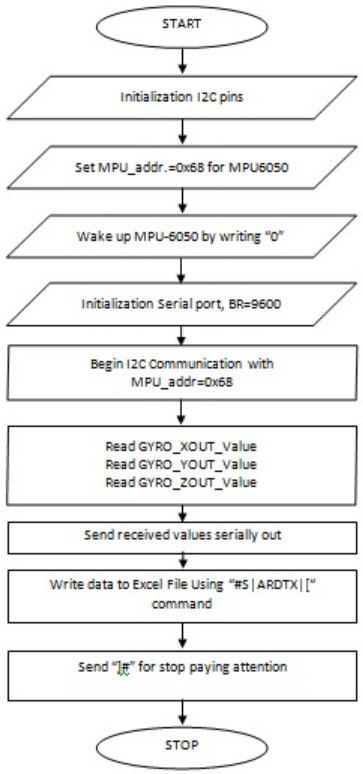


Figure: Flow chart for Arduino program

Note: This flowchart image will be redisgned so that it can be read

Data analytics: Classification of runners

- Gyrometer sensor gives values of its orientation on 3-axes
- We shall classify runners on 3 features:
  - Vertical hopping (from z-axis data when sensor is strapped on lower back)
  - Sidewise movement (from x,y-axis data when sensor is strapped on lower back)
  - Stride Length (from z-axis data when sensor is strapped at ankle)

Vertical hopping classification

- Different runners hop to different levels while running
- Each component of running expends energy
- Our research interests:
  - What is the optimum hop?
  - What parameters does it depend upon?
  - Which runner falls in which class of hopping?

More illustration about 1-D and 3-D hopping will be added in a new slide with relevant mathematics

Sidewise movement classification

- Different runners move sidewise (while running) to different levels while running
- Each component of running expends energy
- Our research interests:
  - What is the optimum sidewise movement?
  - What parameters does it depend upon?
  - Which runner falls in which class of sidewise movement?

More illustration about 1-D and 3-D side-wise movement will be added in a new slide with relevant mathematics

Stride length classification

- Different runners take strides of varying length while running
- Strides depend on:
  - Total height
  - Total Leg length
  - ...
- We chose only two parameters
- Our research interests:
  - What is the optimum normalized stride?
  - What parameters does it depend upon?
  - Which runner falls in which class of striding?

More mathematical illustrations will be added.

Data analytcs

In Progress ...
git address for code: `https://github.com/R-A-M-A-N`
Note:A flowchart for python code will be provided
Results will be added ASAP

Ex-2: Sleep detection in elderly patients

- Problem statement
  - Elderly pateints wearing continous health monitoring system can save device energy if device can detect sleep
  - Sleeping is usually associated with calm physical and mental state

Hardware

- Sensors: Temperature ad heartbeat monitor
- Platform: Arduino
- For data analytics: Python

Figure: Temperature sensor, Pulse Sensor and Arduino Uno

Electronic schematics for hardware

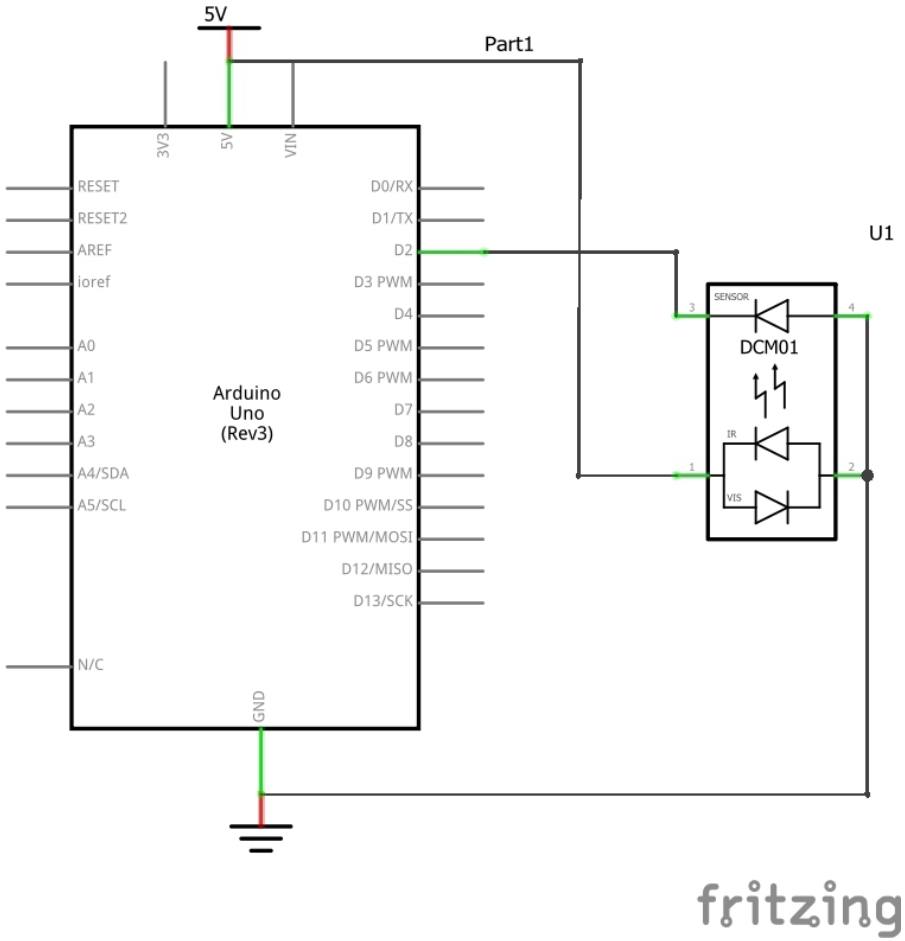


Figure: Connecting pulsemeter unit with Arduino Uno

Data Analytics: Sleeping pattern classification

- Basic Idea:
  - When we sleep, our body parameters stabilize
  - By monitoring body parameters, we can analyse sleeping pattern
  - Sleeping patterns can be identified in simple manner by two features:
    - Time taken to stabilize body parameters
    - Slope of stabilization
- Implementation:
  - Pulse meter and temperature stream data
  - Data is fed to python codes to find time and slope of stabilization

Data analytics

In Progress ...
git address for code:
`https://github.com/kandla/biosensing_elderly`
Following will be added: flowchart of python code, results, their discussion

Conclusions

- Using open source hardware and software, advanced experiments in human health monitoring has been performed
- Python helps in speeding up the process of quality data analytics and result visualizations
- Open source tools can be an attractive feature for high-quality research.