SIT123: Data Capture Technologies

Lab Work Week 6:

Test Motion Sensors for Range and FoV (30 marks)

Today, there are many cheap sensors available on the market, such as passive Infra-Red (PIR) motion sensors. However, a drawback of these sensors is the inconsistency of their output depending on the manufacturer, and also how they perform differently under various environmental conditions.

Due Date Friday 8:00pm, 9th September 2022

Hardware Required

Arduino Board
USB cable
HCSR505 PIR (Passive Infra Red) Motion Detector
Bring your laptop with Arduino IDE installed
A measuring tape
A protractor

Software Required

Arduino IDE

Pre-requisites: You must do the following before this task

1. **Attend Class (Lecture)**
2. **Read this sheet from top to bottom**

Task Overview

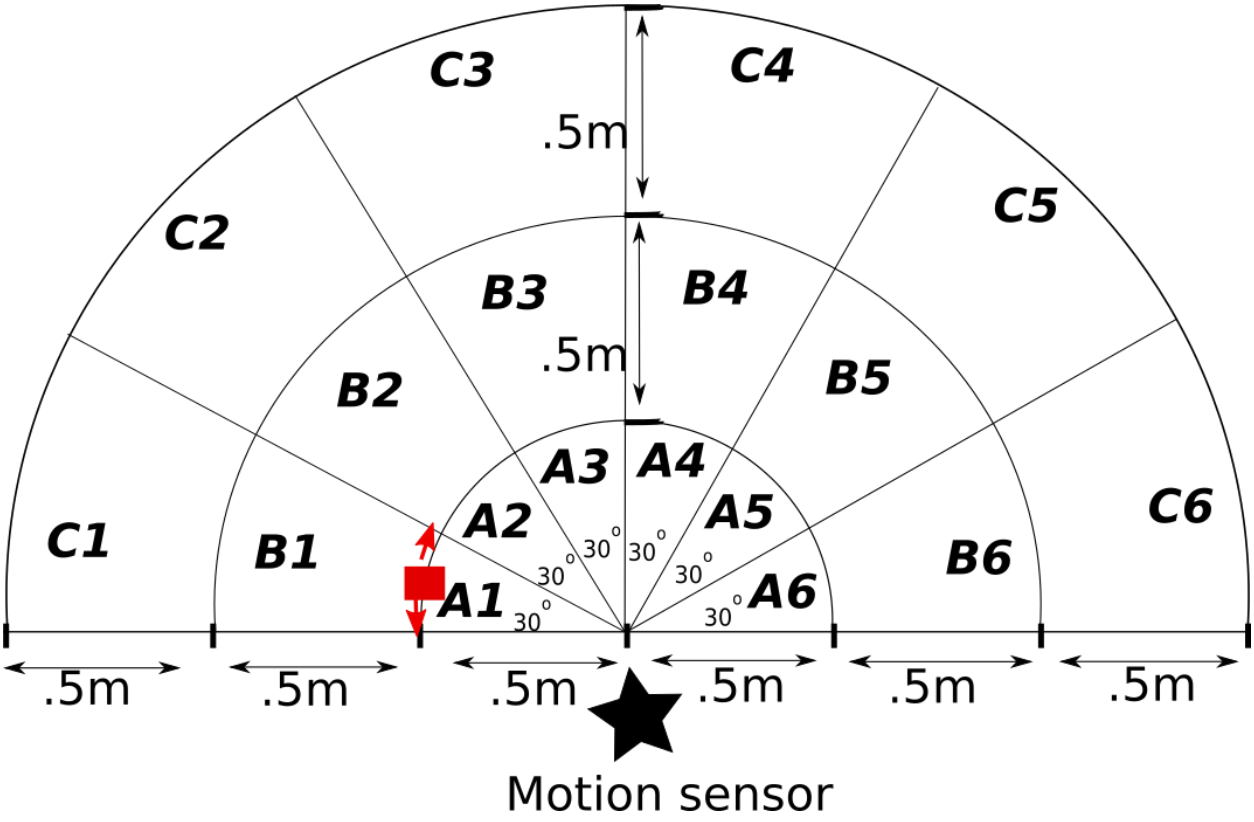
In this task, you will test the PIR Motion sensor for range and FOV (field of view) and calculate its TPR (true positive rate).

Task Submission Details

There are 6 questions in this task. Answer all of them in this word document itself and submit to unit site.

Steps:

1. Find some open floor space indoors (around 3 m wide and 1.5 m in height) and mark the floor area as given in the diagram below:



2. Attach the motion sensor to your Arduino board. You can refer to the Task 2.2P instructions on how to do this.
3. Place the motion sensor connected to your computer at the center as indicated in the diagram.

Q1. Recording Active/Inactive States

We want to find out if the motion sensor can detect movement in each section A1 to A6, B1 to B6 and C1-C6.

- Open the code for motion sensor used in Task 2.2P in your Arduino IDE.
- Ask a friend to step into the edge of section A1 (the red square in the given image) and step sideways bit (look at the red arrows), being careful to stay within the boundaries of A1.
- Check the Serial monitor to see if 'Active' states are being recorded. If you can see Active states, mark that in the table below, and then ask your friend to move the next section A2.
- If you can see 'active' states when they move to A2, ask your friend to be still for a few seconds until you start seeing 'Inactive' states again on the serial monitor, and then ask the friend to step forwards and backwards a bit, being careful to stay within the boundaries of A2. Mark what you see in the table below.
- Repeat this for sections A1 to A6, B1 to B6 and C1-C6.

	A	B	C
1	Active	Active	Inactive
2	Active	Active	Active
3	Active	Active	Active
4	Active	Active	Active
5	Active	Inactive	Inactive
6	Active	Inactive	Active

(5 marks)

Q2. Calculate the True Positive Rate at .5 m Range

a) Enter the motion data you recorded from A1 to A6 in shared file https://docs.google.com/spreadsheets/d/1e3n6oo4L-dc3kydQDnt3OX8wOU6hed8v_XALm0Xo3LI/edit?usp=sharing
If you did the data collection as a group, only enter one reading per group, with all of your names in the relevant cell. Copy the table from the shared file and include here, once there are results from at least 8 groups.

b) Use the results from at least 8 groups to calculate the true positive rates for the FoVs given in the table below. You must show the steps of your calculations in the table.

FoV	True positive rate
180°	3/3 = 1*100 =100%
120°	3/3 = 1*100 =100%
60°	3/3 = 1*100 =100%

(5 marks)

Q3. Calculate the True Positive Rate at 1 m Range

a) Enter the motion data you recorded from B1 to B6 in shared file https://docs.google.com/spreadsheets/d/1e3n6oo4L-dc3kydQDnt3OX8wOU6hed8v_XALm0Xo3LI/edit?usp=sharing
If you did the data collection as a group, only enter one reading per group, with all of your names in the relevant cell. Copy the table from the shared file and include here once there are results from at least 8 groups.

b) Use the results from at least 8 groups to calculate the true positive rates for the FoVs given in the table below. You must show the steps of your calculations in the table.

FoV	True positive rate
180°	1/(1+2) = 0.3333*100 =33.33%
120°	(1+1)/(1+2) =0.6667*100 =66.67%
60°	3/3 = 1*100 =100%

(5 marks)

Q4. Calculate the True Positive Rate at 1.5 m Range

a) Enter the motion data you recorded from C1 to C6 in shared file https://docs.google.com/spreadsheets/d/1e3n6oo4L-dc3kydQDnt3OX8wOU6hed8v_XALm0Xo3LI/edit?usp=sharing
If you did the data collection as a group, only enter one reading per group, with all of your names in the relevant cell. Copy the table from the shared file and include here once there are results from at least 8 groups.

b) Use the results from at least 8 groups to calculate the true positive rates for the FoVs given in the table below. You must show the steps of your calculations in the table.

FoV	True positive rate
180°	1/(1+2) = 0.3333*100 =33.33%
120°	(1+1)/(1+2) = 0.6667*100 =66.67%
60°	3/3 = 1*100 =100%

(5 marks)

Q5. Based on the above, what can you say about the range and FoV of the motion sensor tested? Justify your answer, giving reasons.

(5 marks)

With the setup described above, sensors were able to detect movement across all segments of A at a distance of 0.5 m and a field of view of 180 degrees (A1 to A6). All points of view in Section A were considered "Active" readings. Each field of view (FOV) has a 100% true positive rate at a distance of 0.5m. At 1m and 180 degrees FOV, the sensor read "Active" for B1 through B4 but "Inactive" for B5 and B6. 1m away with 120 degrees of field of view, the sensors read "Active" for B2 through B4 but "Inactive" for B5. Further, both B3 and B4 were "Active" when the FOV was set to 60 degrees and the distance was 1 metre. At a distance of 1.5 m and a field of view of 180 degrees, the sensors registered "Inactive" for C1 and C5 and "Active" for C2, C3, FOV4, and C6. While the sensors identified "Active" for C2 through C4 and "Inactive" for C5 at a field of view (FOV) of 120 degrees and a distance of 1.5 metres, they detected "Active" for C3 and C4 at a FOV of 60 degrees and a distance of 1.5 metres. In conclusion, the sensor's accuracy degrades with increasing range.

Q6. Propose an experiment to find the True Negative Rate (TNR) of this sensor.

(5 marks)

A experiment that is aimed to determine whether or not motion can be detected in a location where none should exist, such as a glass case that contains the coffin of a famous person who has just passed away and is on display. Readings taken by the sensor between the hours of 12 p.m. and 12 a.m. may tell us a lot about the true negative rate that has been there during the whole time. During this experiment, the 'Inactive' value will behave as the True Negative, while the 'Active' value will act as the 'False Positive.'

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Lab Work Week 7: Data Visualization (30 marks)

In this task, we will design and develop visualizations for sensor data.

Due Date Friday 8:00pm, 9th September 2022

Pre-requisites: You must do the following before this task

1. **Attend Class (Lecture) & Online Seminar**
2. **What following resources and videos on introduction to Tableau and how to build basic visualizations** (you might need to provide your details to be able to watch the videos)
   https://www.tableau.com/learn/tutorials/on-demand/tableau-interface
   https://onlinehelp.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-connect.html
   https://www.tableau.com/learn/tutorials/on-demand/getting-started
   https://www.analyticsvidhya.com/blog/2017/07/data-visualization-made-easy/

3. **Read this sheet from top to bottom**

Task Objective

This is an individual task. You will need to design and develop a visualization for the sensor data shared here:
https://drive.google.com/file/d/1ResskTdqMN2Md770ICK99ehIWURBSsgz/view?usp=sharing
https://drive.google.com/file/d/1m8uRS9a7UOJrQn2mfCD_XYbF5AJo6JZH/view?usp=sharing

Software Required

Tableau - Available in the lab

Task Submission Details

There are 5 questions in this task. Answer all of them in this word document itself and submit to unit site.

Q1. What data types can you identify in the two data sets given? Use the information provided in the lecture, and identify the data types available in your datasets.

(3 marks)
Dataset 1's nominal data in the'stamp' column was used to determine the data type. Numbers may be found in the "hum," "millis," and "datetime" columns. Data of the "hum" and "datetime" types are intervals. The information in'millis'is a ratio. Dataset 2 is comprised of nominal information derived from the stamp columns. All of the numbers in the'millis,' 'datetime,' and 'temp' columns are quantitative. "temp" and "datetime" information is of the interval type. The'millis'data set is a ratio.

Q2. Select one of the two data sets. Using your understanding of the given data, identify which visual variables are suitable to be used with your selected data set. Provide details of the visual variables and your justification here.

(4 marks)

Mathematical information, often known as numerical data, is a specific kind of data that is conveyed by numerical representations rather than through words. To properly collect mathematical information, one must use a numerical framework, as the term implies. There are two types of data in mathematics: discrete data and continuous data. Both types may be utilised to find the right visual variable to pair with numbers.
The Quantitative Variable
For quantitative considerations, mathematic traits and estimate are key. The clinical model we've developed uses age as an example of a quantitative variable because of the many mathematical properties it might take on. Quantitative factors include, for example, height and weight.
To start, consider quantitative visual elements. Images with numerical values are used to display numerical data such as ranks, ranges, and percentages. The purpose of the quantitative visual variable is to illustrate the degree to which, or the need for, one substance is in comparison to another.
Images' relative relevance may be inferred by adjusting the visual variable's size. The volume of traffic along a roadway or the volume of water flowing through a canal are both indicators of the line's thickness, and hence, of the corresponding stream levels.

Value and saturation of the visual variable speak to varying degrees of detail or priority in an information value. You should prioritise either the saturation or the value of a colour, but not both. Various quantitative features are discussed, with a corresponding difference in immersion or value, and all are related to a single variable.
Again, the focal visual variable emphasises exposure to quantitative traits that might be exploited.

Q3. Design a visualization in Tableau to visualise one of the given data sets. Your visualization does not necessarily need to include all the visual variables you have listed in Q2. It should however be easy to understand, and have a clear message. Provide a screenshot of your visualization here.

(10 marks)

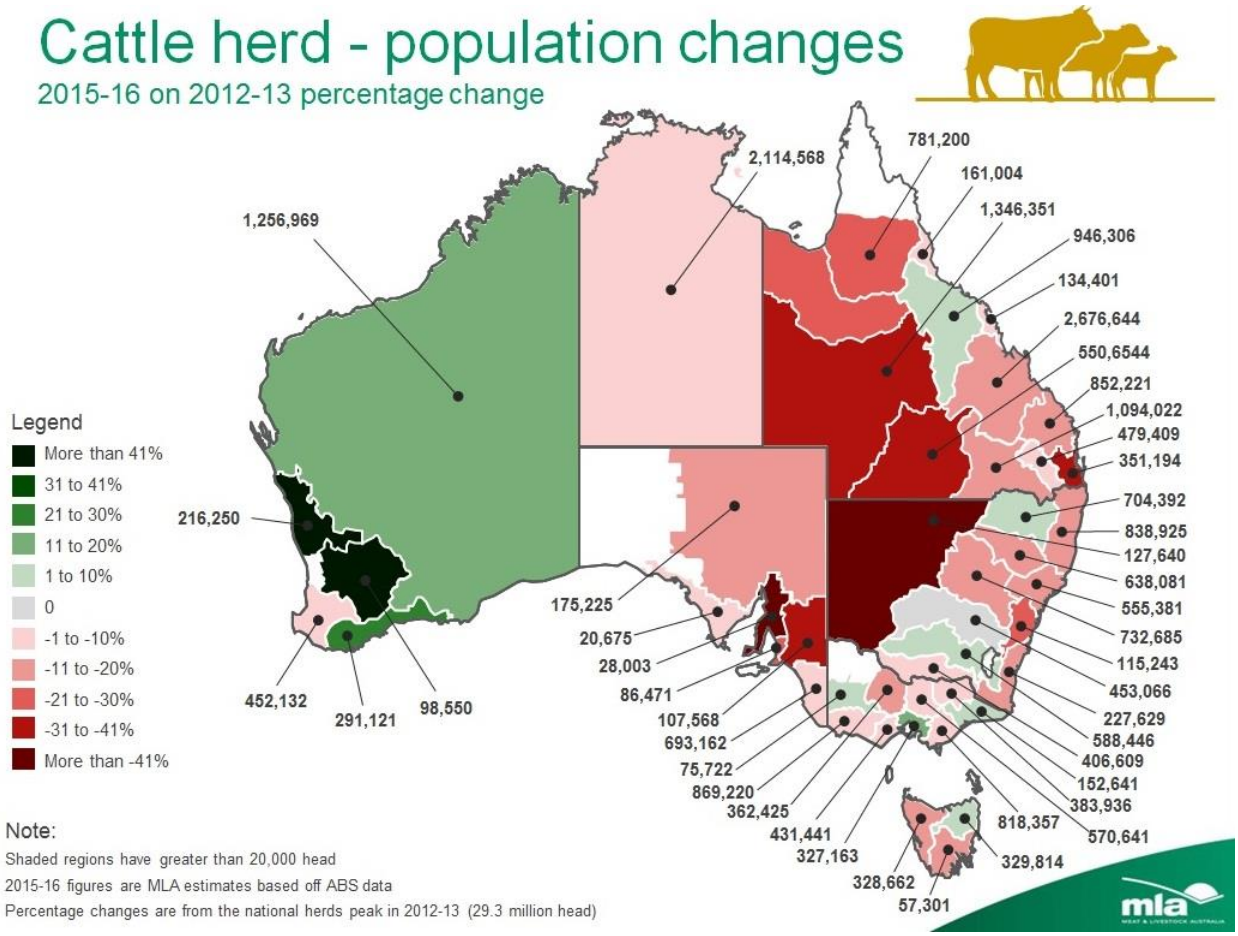
Q4. Use the visualization in Q3 to provide some insights to the sensor data. Provide the discussion below.

(5 marks)

Q5. Use your visualization knowledge to critique the given visualization below. Consider the following in your critique:

- Who is the audience? (expert? non-expert?)
- What questions does this visualization answer?
- What design principles best describe why it is good / bad?
- Why do you like / dislike this visualization?
- Can you suggest any improvements?

a) Cattle herd – population changes in Australia (4 marks)



Your Critique:

Anyone interested in cattle farming or transportation in Australia is likely to find this infographic useful. Farmers, butchers, distributors (like Woolworths or Coles), and even some environmentalists might be considered stakeholders. This map clarifies not only the overall number of cattle in Australia, but also the growth and decline of the cow population in each state. Designing with different colours for each segment is a fantastic decision since it shows the audience where the increases and declines have happened in an easily understood pie chart. The decision to designate each portion with the total number of cattle in that region is both instructive and poorly designed. This makes it difficult to distinguish between different regions of Australia and makes the infographic difficult to read. On the other hand, without these figures, it would be impossible to have a clear picture of the total number of animals present. A modification that might be done to enhance this infographic is to replace the lines pointing to the smaller plots of land with numbers, and to add those numbers to a legend where the corresponding numbers reveal how many cattle are in that area. Here's an illustration of how the key would look: 1 - 102,2002 99,2333 250,334

b) Go to http://covid-19-au.com and check the interactive visualizations (4 marks)

Your Critique:

- Who is the audience? (expert? non-expert?)
- What questions does this visualization answer?
- What design principles best describe why it is good / bad?
- Why do you like / dislike this visualization?
- Can you suggest any improvements?