Investigation

a.   Evidence of research on the brief

– Refer directly to what the brief says about **forests** regarding **importance of monitoring** <u>and</u> **threats**.

– Include at least two reputable sources and list them in your **Bibliography**.

Note: Begin with the links provided in the Brief. Then do your own research.

b.   Evidence of modelling and how it is applied in real systems

– Explain how modelling is used in national or international forest-monitoring systems

(e.g., growth models, fire-risk models, scenario simulations, satellite detection).

        – Include references for any examples you mention.

Note: Modelling is where data is collected with the view to making some form of a prediction.

c.   A clear explanation of how this research shaped your project direction

– Show how reading the brief and your sources influenced:

        - what **data** you decided to collect

        - what **processes** you chose to simulate

        - what **type** of simple modelling you will apply

Note: All of this must be **specific** to **your** project.

Sample: Research on the Brief

The brief explains that forests support environmental wellbeing by storing carbon, regulating climate, producing clean air, and protecting biodiversity. Research shows they are increasingly affected by drought, storms, changing rainfall, and disease, all of which place stress on soil, vegetation, and wildlife **(Department of Agriculture: Forestry in Ireland)**. Climate-science sources also note that rising temperatures and shifting weather patterns are intensifying these pressures and making forests more vulnerable over time **(Climate MIT; Climate Council).**

Research also shows that **modelling** is central to predicting changes in forest conditions. International platforms use satellite-based change detection to track shifts in vegetation cover and dryness, helping identify patterns linked to fire risk or early deforestation **(InfoAmazonia – PRODES and DETER).** Climate-science sources explain how rainfall, temperature, and soil moisture data are analysed to **predict** when conditions may become stressful **(European Climate; Climate Council)**. Biodiversity studies further show that long-term trends in light and habitat conditions can indicate changes in ecosystem resilience **(Teagasc).**

My **research shaped the direction of my project** by showing that early changes in forest wellbeing are often reflected in variables such as moisture, temperature, and light. Because of this, I decided to focus on collecting these types of environmental data, as they act as early indicators of stress. The research also highlighted the value of simple **modelling**, where patterns or thresholds can be used to interpret readings and signal when conditions may be becoming less favourable. Based on this, I chose to simulate a simplified forest process using **rule-based modelling**, allowing my system to show clear changes in wellbeing as the sensor data varies.

State:

-   **what** the purpose of the system {existing solution} is <u>and</u> **how** the it works {focus on modelling it uses}

-   **how** the system {existing solution} **improves** detection <u>and</u> **improves** forecasting / better predictions

-   a **limitation / weakness** of the system {existing solution} e.g., relies on large datasets, affected by weather, misses small changes).

Sample: Existing Solutions

National Forestry Modelling Systems (Ireland)

National organisations such as the National Parks and Wildlife Service (NPWS), Coillte, and Teagasc highlight how modelling supports forest management in Ireland. These groups use tools such as forest-growth simulations, biodiversity-impact modelling, climate-pressure forecasts, and long-term scenario analysis to understand how forests respond to drought, heat, pests, and habitat change. This modelling **improves early detection** of stress and helps guide decisions about conservation and sustainable forestry. A **weakness** is that these models can be limited by gaps in local data or sudden environmental changes, which may reduce their accuracy in real-time conditions.

International Deforestation-Monitoring Systems

Systems such as Brazil's PRODES and DETER rely on continuous modelling and satellite-based change detection to monitor forest loss. PRODES provides annual measurements, while DETER generates rapid alerts when clearing begins. These systems **improve early detection** and help authorities respond before deforestation becomes widespread. Their main **weakness** is that satellite monitoring can miss small-scale activity or become less effective under cloud cover.

Early-Warning Wildfire and Disaster-Risk Platforms

Platforms such as UN-SPIDER and the WWF wildfire-risk system use fire-spread simulations, environmental-risk models, and temperature-humidity-vegetation modelling to estimate wildfire danger in advance. This **improves prediction of where fires may start** or spread and helps reduce damage through earlier intervention. A **weakness** is that rapidly changing weather and vegetation conditions can affect the accuracy of these predictions.

Final Idea

Student Guidance:

State:

- **what** your system will measure (temperature, light, soil moisture, sound).

- **one immediate reaction** the Microbit will make (e.g., showing a warning when a value changes).

- **one ongoing process simulation** your system will imitate (e.g., rising risk levels when conditions persist).

- the **role** of your **Python model**

Sample: Final Idea

Based on my investigation, my final idea is to build an embedded system that measures key indicators of forest stress such as temperature, light, soil moisture, or sound **[What my system will measure]**.
The Microbit will give an immediate response by showing a warning when any value moves outside a normal range **[Immediate reaction]**.
The system will also simulate an ongoing process, such as increasing wildfire risk, by moving from a low to a medium to a high alert when conditions persist **[Ongoing process simulation]**.
A Python model will examine simple trends or patterns in the data so the system can react to longer-term changes **[Role of Python model]**.

Limitation

Student Guidance:

- Identify **one** realistic limitation and **explain** why it is a limitation

One limitation is that my system can only measure a very small area, so it cannot match the accuracy or scale of national or satellite-based modelling. The modelling I use is also much simpler than professional simulations, so it can only give basic indicators rather than detailed predictions.

Checklist for Investigate Stage

1. **Investigating the Brief**: This is a 'general' investigation about **forests** regarding **importance of monitoring** <u>and</u> **threats**.

2. **Existing Solutions:** This is where you investigate 'specific' solutions from both the links provided and your own research. With evidence of modelling.

3. **Final Idea:**   Lay out your final idea **briefly**. What will it predict {model}.

4. **Limitations:**   Give at least **one** limitation.

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