Project Proposal: Integrating a Tilt Sensor for MSP432P4XX Robot Inclinometer

Objective:

The primary objective of this project is to design and integrate a tilt sensor system into an MSP432P4xx microcontroller-based robot for enhanced navigation on steep and uneven surfaces. The tilt sensor, acting as an inclinometer, will provide real-time information about the robot's orientation and will trigger visual warnings based on the severity of the incline. The system will be designed to ensure the MSP432P4xx robot avoids dangerous tipping points and makes informed decisions regarding its movement when encountering challenging terrains.

Background and Methodology

MSP432P4xx microcontrollers are versatile platforms used in a wide range of applications, including robotics. However, navigating steep, uneven, or off-road terrains remains a challenging task. To address this issue, our project focuses on integrating a tilt sensor, which will serve as an inclinometer, to enhance the MSP432P4xx-based robot's ability to traverse such surfaces safely. The inclinometer will measure the angle of inclination and provide visual warnings to the robot operator as it approaches dangerous angles, ensuring the robot's stability.

Our approach will involve the following key steps: We will choose a suitable tilt sensor that can accurately measure angles and provide real-time data to the MSP432P4xx microcontroller. The selection will be based on factors such as accuracy, range, and compatibility with the MSP432P4xx platform.The selected tilt sensor will be integrated into the MSP432P4xx-based robot's existing control system. This will involve establishing the necessary connections and ensuring the sensor can communicate with the MSP432P4xx microcontroller.

The robot's control software, running on the MSP432P4xx microcontroller, will process the data from the tilt sensor and set specific threshold angles for warnings. The software will be programmed to detect the severity of incline and trigger warnings accordingly. We will implement a visual warning system, which may include changing LED colors based on the angle's severity and initiating a blinking pattern when the robot is approaching a tipping point.

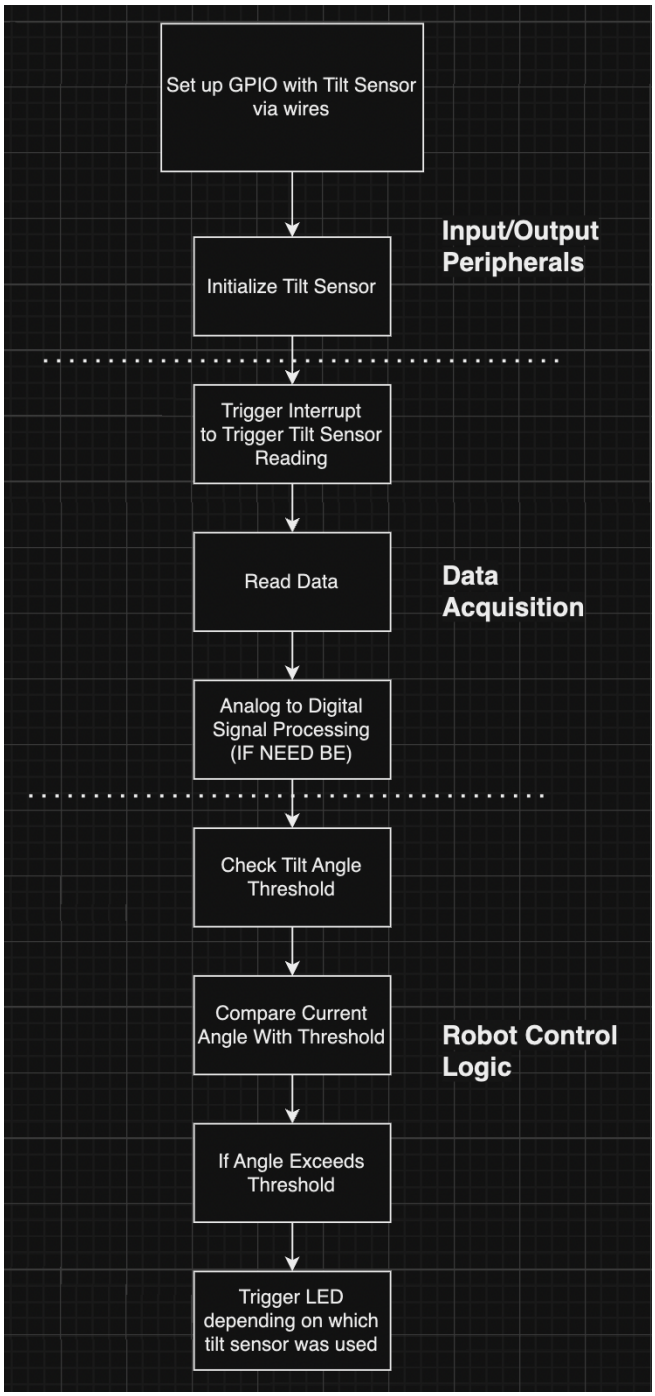
To test the system's effectiveness, we will set up an obstacle course with various angles and articulations that mimic off-road conditions. The MSP432P4xx robot will navigate through these obstacles, and the inclinometer system will provide feedback and warnings as required.

Depending on the severity of the incline and the warnings received, the MSP432P4xx robot's control software will make navigation decisions, such as reversing, changing its path, or adjusting its speed to prevent tipping. All of this control software will be written in Code Composer Studio to manage the sensor data, process the data for angle calculations, and control the LED indicator for warnings.

The modules to be considered are gpio_pins (on-board) and interrupts to handle asynchronous events, such as data acquisition from the tilt sensor in order to handle cases when the tilt angle surpasses a certain threshold.

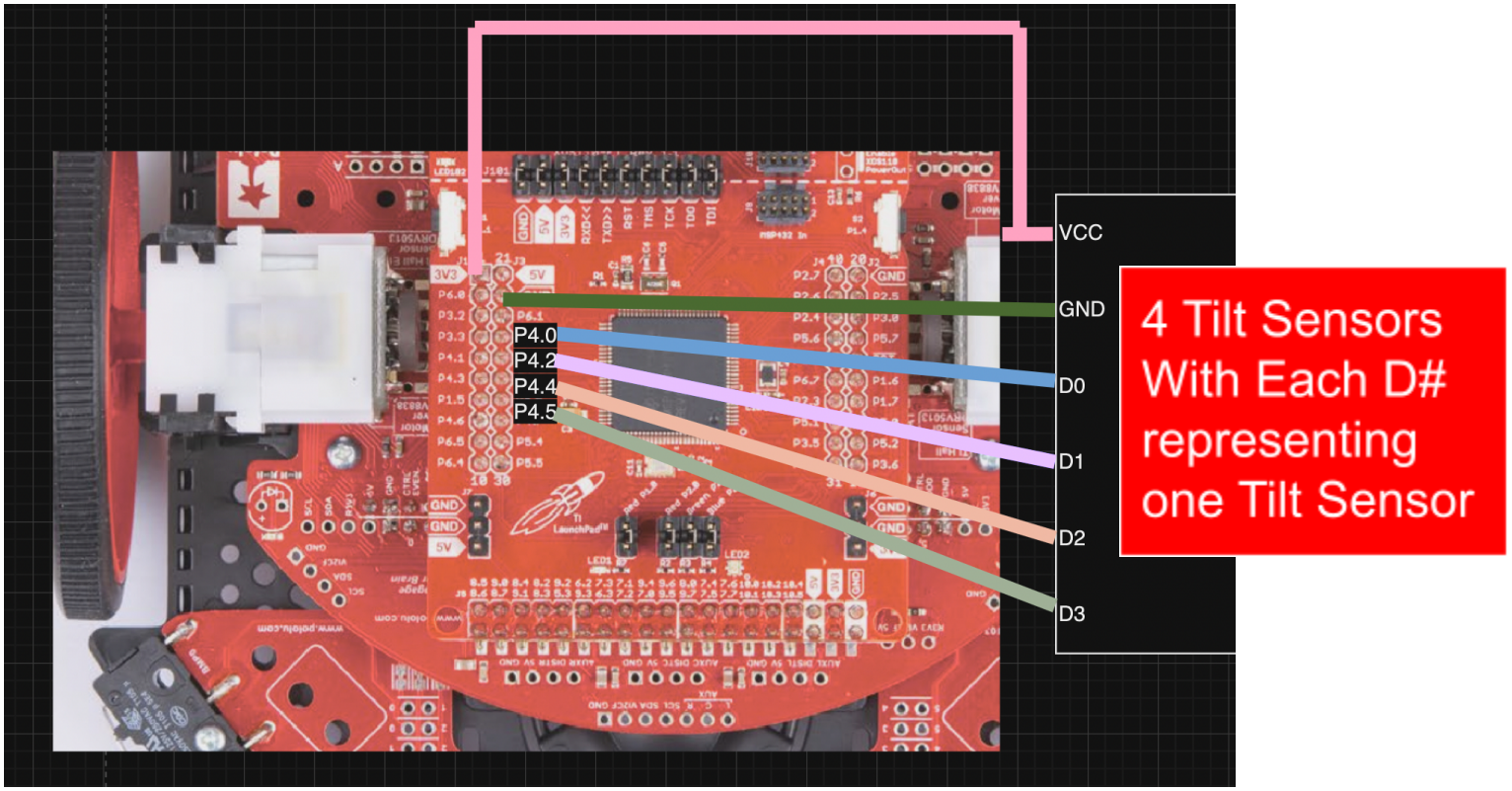
Block Diagram

The following block diagram illustrates the integration of the tilt sensor and the components involved in the system for the MSP432P4xx robot:



Pinout Plan

The pinout plan for connecting the tilt sensor to the MSP432P4xx microcontroller is provided below with the necessary pins, wiring connections, and voltage levels required for proper integration:



MSP432 Launchpad	Tilt Sensor
3V3	VCC
GND	GND
P4.0	D0
P4.2	D1
P4.4	D2
P4.5	D3

Components Used

The following components will be used in this project:

- Tilt Sensor/Inclinometer (A high-precision tilt sensor capable of measuring angles accurately and quickly)
    - Product Link: https://www.amazon.com/dp/B00RJJL5Q8
    - Details: https://osoyoo.com/2017/07/18/sw-520d-tilt-switch-sensor-module/
- MSP432P4xx Microcontroller: The MSP432P4xx-based robot platform that includes several LED indicators.
- Micro USB cable