College of Engineering, Pune

Dept. Of Electronics and Telecommunication Engineering

Microcontroller and Applications PROJECT- 2021-2022

PROJECT NAME: Rain Sensing Automatic Car Wiper Using MSP430F5529 Launchpad

DONE BY: RUPALI DEBNATH – 112007049

ARCHITA SINGH – 112007065

GUIDED BY:- Prof. Miss NEELIMA R KOLHARE

Contents

1. Abstract...3

2. Introduction...3

3. Block Diagram...4

4. Related Work...4

5. Experimental Setup...5

    a. MSP430F5529 LaunchPad

    b. Rain Sensor Module

    c. Servo Motor.

6. Flowchart...9

7. Detailed system design and working...10

8. Energia Code...11

9. Results and Conclusion..13

10. Future Scope and Market Potential...13

11. References...14

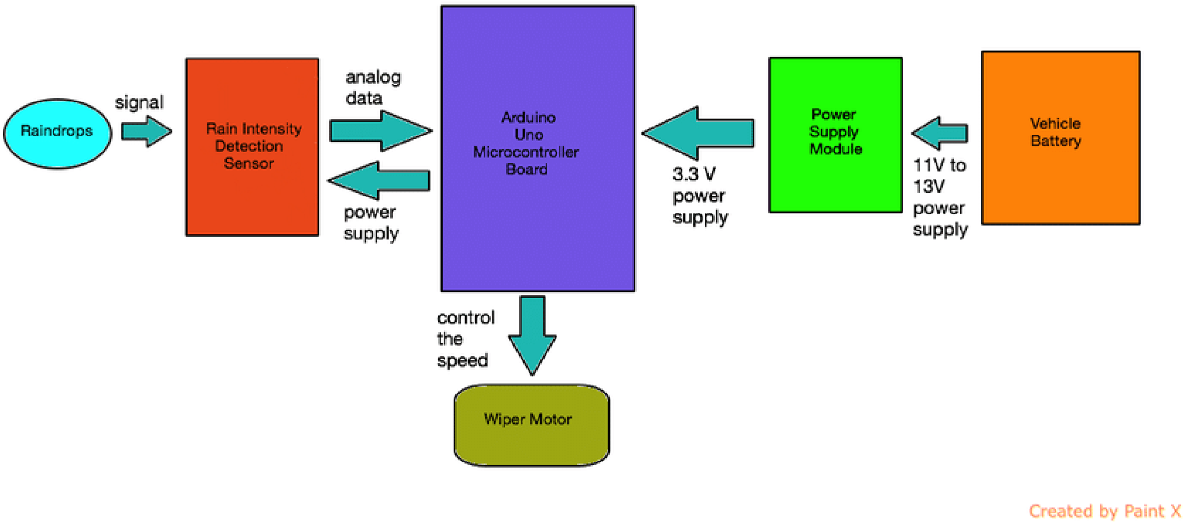
1. Abstract:

Over the past few years the automotive industry has aggressively researched ways to develop systems for safety, to save humans life. Generally working of a car wiper is based on manual switching. In this case the driver has to switch ON the power button to turn on the wiper. It complicate things because the driver has to concentrate simultaneously on driving and wiper. With drivers exposed to increased distraction, automatic rain sensing wiper system becomes more appealing feature, as they eliminate the risk and distraction to turn on the wiper manually. In this automatic wiper system, a rain sensor, microcontroller and a driver integrated circuit is used to convert manual operation into automatic operation. When water falls on the rain sensor, the sensor sends the signal to the microcontroller and then the microcontroller processes the data and energizes the driver IC to turn on the wiper. With these modifications automatic cleaning of the glass can be done without the involvement of the driver.

2. Introduction:

Today's car wipers are manual systems that work on the principle of manual switching. So here we propose an automatic wiper system that automatically switches ON on detecting rain and stops when the rain stops. Our project brings forward this system to automate the wiper system not need manual intervention. For this purpose, we use a rain sensor along with a microcontroller to drive the wiper motor. Our system uses a rain sensor to detect rain, this signal is then processed by a microcontroller to take the desired action. The rain sensor works on the principle of using water for completing its circuit, so when rain falls on it, the circuit gets completed and sends out a signal to the microcontroller. The microcontroller now processes this data and controls the motor. This system is equally useful for Aircraft and a smaller version of this can be used by motorbikers in their helmets so that they can drive easily in rains. Figure 1 shows the block diagram for our proposed idea.

3. Block Diagram of Proposed Model:



4. Related Work:

In the current scenario, only high-end vehicles employ intelligent rain-sensing automatic wiper systems. Our system is modeled to demonstrate how useful is an automatic wiper system that adjusts speed itself based on rainfall intensity. Such a system improves the safety of a ride. There are many instances of accidents occurring during heavy rainfall due to lack of proper vision. In many cases, these accidents were due to manual errors (for example: not increasing the speedof the wiper) from the driver. An automatic, intelligent system like ours removes any manual errors. Our system adjusts wiper speed according to the intensity of rainfall and hence improves safety. Nowadays some models of Ford and Hyundai are also implementing an automatic wiper systemin their vehicles.

5. Experimental Setup:

MSP430F5529 Launchpad:

MSP430 is designed for low cost and specifically low power consumption.

MSP stands for Mixed Signal Processori.e. can give both analog and digital signals for inputs since it contains ADC. It is like a controller because most of the peripheral devices are available in the processor.

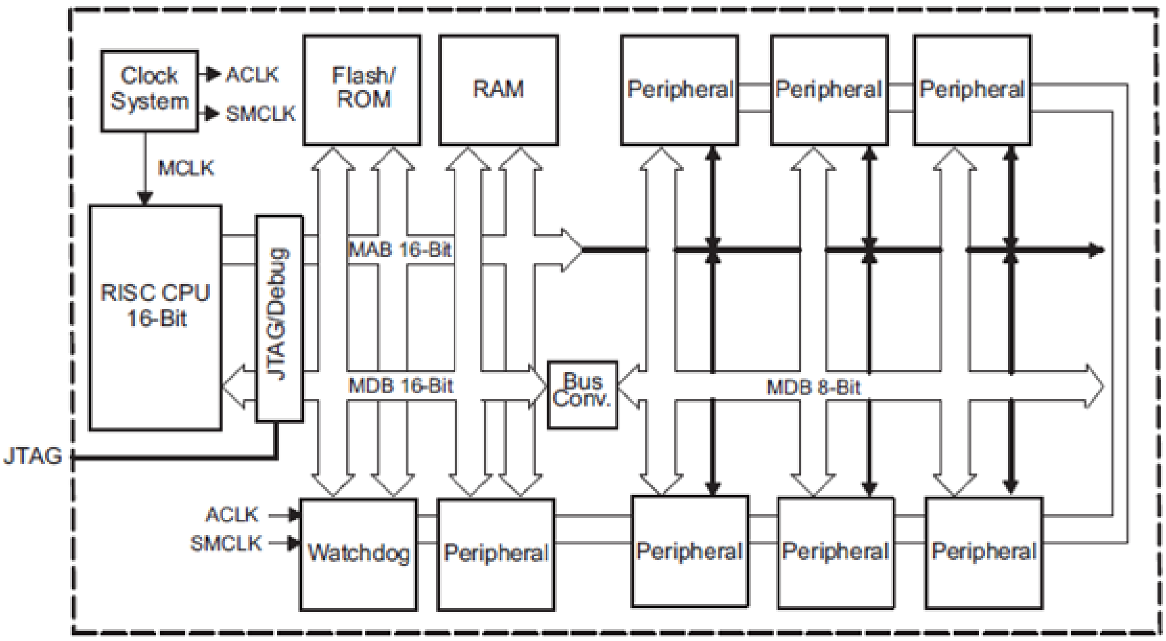
MSP430F5529:
MSP – processor family
F – Device type
5 – Series
529 – Feature set

Features:

- C compiler friendly
- RISC (Reduced Instruction Set Computer) Architecture:
    - 51 instructions
    - 7 addressing modes
    - Constant generator resistors (can store 6 constants to be used)
- Size of almost all instructions is same and almost all instructions can be executed in one clock cycle.
- Data bus size: 16 bit
- Address line: 20 bit, therefore we can interface 1M bytes (2e20) of memory to the MSP.
- Single cycle resistor operation
- Bit, byte and word processing
- 1MB unified memory map
- Extended addressing modes are available for improved code density and faster execution.
- Ultra low power consumption: 160 micro ampere for million instructions per second.
- Integrated low dropout regulator (DC linear voltage regulator that can regulate the output voltage), brownout reset (protection circuit which prevents reduction in the power supply voltage below the level required for reliable operation), watch dog timer (used to detect and recover from computer malfunctions) and RTC (real time clock).
- Operates on 12MHz with a power supply of 1.8V.

- Specifications:
    - Supply voltage: Up to 3.6V
    - RAM: up to 66kB
    - Other interfaces: UART, SPI, I2C
    - Clock frequency: up to 25MHz
- Contains:
    - Clock generator
    - Central Processing Unit
    - ROM or EPROM
    - RAM or EEPROM
    - Peripheral modules
    - Control

General Block diagram:



Clock Generator:
MCLK – master clock signal (highest clock) which CPU operates on
SMCLK – (slower) sub master clock signal, used for watch dog timer and faster peripheral devices
ACLK – (slowest) auxiliary clock signal for slower peripheral devices

CPU:
RISC CPU – 16 bit data
16 bit ALU
16 registers
Instruction control logic

4 registers are for special purposes: Program Counter PC, Stack Pointer SP, Status Register SR and Constant Generator CG.
All registers except R3/CG2 and part of R2/CG1 can be used as general purpose registers.

CPU features:

- 27 instructions and 7 addressing modes
- Orthogonal architecture with every instruction usable with every addressing mode.
- Full register access
- Single cycle register operations
- 16 bit data bus, connects all peripheral devices of 16 bits to CPU
- 16 bit address bus, connects all peripheral devices
- Word and byte addressing and instruction formats.

JTAG debug – downloading program
Flash/ROM memory – storing program/code memory

RAM – storing data connected via:
MAB – memory address bus of 16 bits which connects all peripheral devices
MDB – memory data bus of 16 bits connects peripheral devices of 16 bits to CPU

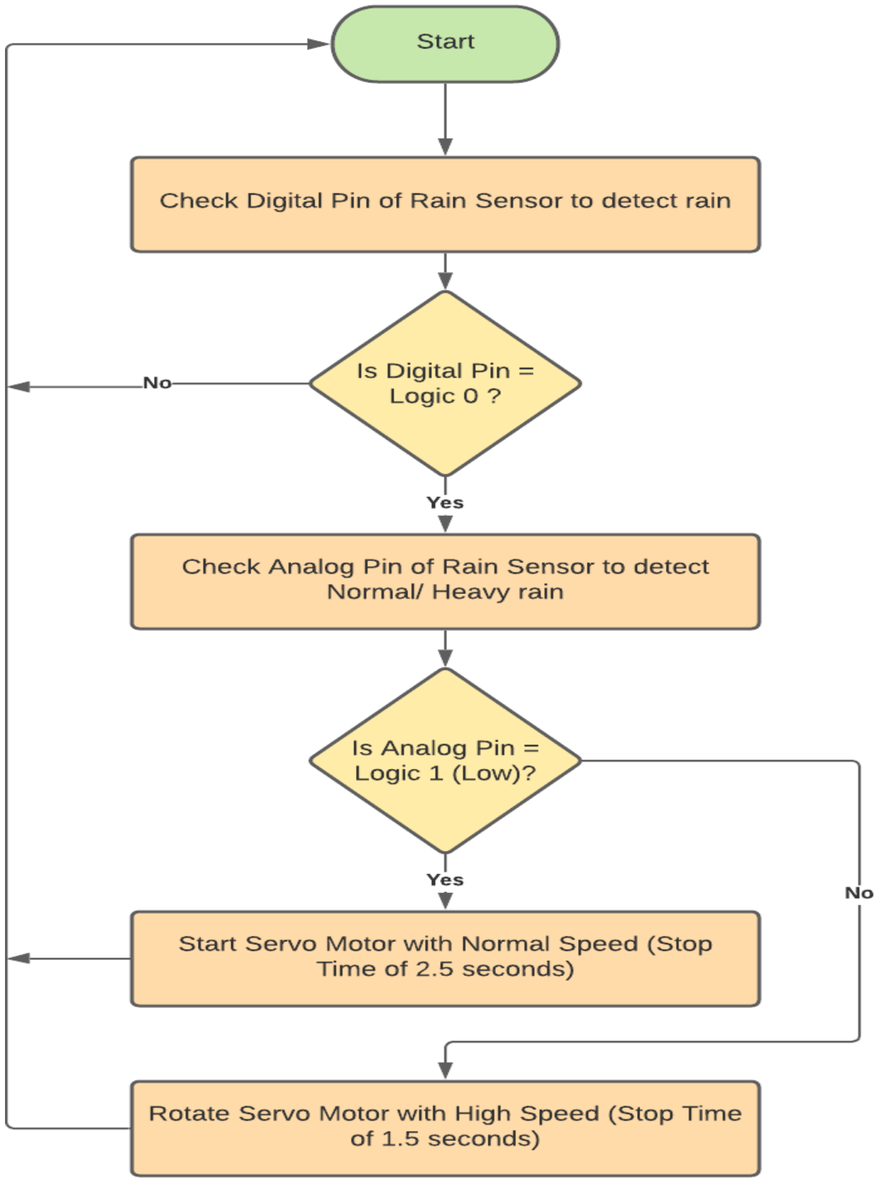
Rain Sensor Module

A rain sensor module is an easy tool for rain detection (Gupta et al.). It can be used as a switch when a raindrop falls through the raining board and for measuring rainfall intensity. Figure 3 shows a depiction of a typical Rain Sensor Module. Due to its compact design and light weight, it can be easily attached into any system. The module features, a rain board, and the control board that is separate for more convenience, a power indicator LED, and sensitivity adjustable through a potentiometer. A raindrop sensor is a board coated with nickel in the form of lines. It works on the principle of ohms law. When there is no raindrop on board. Resistance is high so we get high voltage according to V=IR. When raindrop present it reduces the resistance because water is a conductor of electricity and the presence of water connects nickel lines in parallel so reduced resistance and the reduced voltage drop across it.

Servo Motor

Servo motors are self-contained mechanical devices that are used to control the machines with great precision. . Usually the servo motor is used to control the angular motion from 0° to 180° and 0° to 90°. The servo motor can be moved to a desired angular position by sending Pulse Width Modulated (Holtz, 1992) signals on the control wire. The servo understands the language of pulse position modulation. A pulse of width varying from 1 millisecond to 2 milliseconds in a repeated time frame is sent to the servo around 50 times in a second. The width of the pulse determines the angular position. For example, a pulse of 1 millisecond moves the servo towards 0°, while a 2 milliseconds wide pulse would take it to 180°. The pulse width for in-between angular positions can be interpolated accordingly. Thus a pulse of width 1.5 milliseconds will shift the servo to 90°. It must be noted that these values are only approximations. The actual behavior of the servos differs based on their manufacturer. A sequence of such pulses (50 in one second) is required to be passed to the servo to sustain a particular angular position. When the servo receives a pulse, it can retain the corresponding angular position for the next 20 milliseconds. So a pulse in every 20 millisecond time frame must be fed to the servo. Figure 4 shows an example of the servo motor we have used in our implementation, while Figure 5 shows the operation of servo motor based on Pulse Width Modulated signals.

6. FLOWCHART:



7.Detailed system design and working:

In the event of rainfall, the rain sensors have a water column or a flow column which results in the change in resistance. Thus, the sensor acts as a variable resistance board. The relationship between rain intensity and resistance has been determined to be inversely proportional to each other. The increase in the number of raindrops results in a decrease in the resistance of the sensor. The sensor then transmits the signal, the signal is received using a microcontroller which determines the intensity and transmits the signal to servo motors in the form of pulse width modulation and the mode of action of wipers is then switched on in accordance with the intensity of the rain falling.

The sensor is designed in such a way that its size does not impair the driver's view. The sensor is entirely immune to environmental particles and elements that may come in contact with the sensor. Thus, the sensor does not send false alarms if such an event were to take place. Through a working example, we hereby attempt to explain the working of the rain sensor. Say, the resistance in the resting sensor is 1000 KΩ. In a mild rainfall, the height of the water column inside the rain sensor is little as the intensity of the rain is low. The resistance of the sensor drops down and now gets into the range of, say, 900-400 KΩ. When rainfall increases, the build-up and accumulation of rain drops in the sensor increase, and thus the resistance falls down to 300-100 KΩ.

As the rainfall's intensity increases, the resistance decreases. The decrease in resistance is taken in as a signal through which the MSP430, a microcontroller , determines the intensity of the rain. The signal is transmitted to the servo motor which then operates the working and movement of the wiper blades. As the intensity increases, the speed of the wipers increase.

8.CODE :

```
#include <LiquidCrystal.h>

#include <Servo.h>

Servo myservo;

int pos = 0;

int sensorValue = 0;

void setup() {

 Serial.begin(9600);

 myservo.attach(P1_2);

}

void wipe(int Speed)

{

 for (pos = 180; pos >= 0; pos--) {

   myservo.write(pos);

   delay(3);

 }

 for (pos = 0; pos <= 180; pos++) {

   myservo.write(pos);

   delay(3);

 }

 delay(Speed);

}

void loop()
```

```
{
sensorValue = analogRead(A0);
Serial.println(sensorValue);
if(sensorValue>600){
myservo.write(180);
delay(1000);}
if(sensorValue<=600){
wipe(sensorValue);}
}
```

9. Results and Conclusion:

Thus, we have implemented a model that senses rains and automatically switches on the wiper and adjusts its speed according to the intensity of the rain. As the intensity of the rain increases, the speed of the wiper increases to a certain level. Figure shows the workflow for our proposal. The microcontroller checks for the digital pin and analog pin inputs of the rain sensor. When there is slight water on the sensor, the digital pin is set to logic ’0’. This is used to detect presence of rain water. To check the intensity of rain, we monitor the analog pin output of the rain sensor, whose threshold can be adjusted manually through an attached Potentiometer to indicate how much water should be considered as high rain. According to our observations, the wiper takes 2.2 seconds when a drop of water is poured on the sensor, while it takes only 1.4 seconds when the sensor is submerged in a glass of water. We learned how to interface servo motor with MSP430F5529 LaunchPad and the rain sensor module interfacing with MSP430. Figure shows the prototype we have developed to demonstrate our idea.

10. Future Scope and Market Potential:

The world will one day move in self-driving cars is already evident in a series of functions that today's cars have begun to perform without human intervention. Even in the models sold in India, some cars tell you the route and journey time, park on their own, start the wipers if it is raining, switch on the lights if it gets dark, warn you of moving objects at night, inform you of a school in the vicinity, detect dangerous lane departures and raise alarm if the driver is drowsy. You can control music volume by moving fingers in the air and telling your car what song to play.

One of the primary objectives in this task was to make a de- sign which is compact and easy to integrate with a complex system such as a vehicle. Also, we wanted to demonstrate how these relatively novel sensors can be integrated with a microcontroller to develop an application. Modifications in the circuit can be made with the objective of creating a system on-chip, which can be easily plugged into existing vehicles. The sensor proposed in this model is low cost and efficient to a great extent, however with the development of more high quality and accurate sensors, much more desirable and reliable outputs can be obtained. Another interesting area to explore into is controlling the speed of the wiper to a more accurate sense. Currently, the wiper moves at two different speeds. By modifying the code, we can have different speeds for a different amount of rain. Also, we can use this automated car wiper along with other automated features to make a Smart Car.

11. References:

Ashik, K. and Basavaraju, A. Automatic wipers with mist control. *American Journal of Engineering Research (AJER)*, 3(4):24–34, 2014.

Gupta, D., Gupta, A., Singh, N., Affan, Q. M., and Ku- mar, A. Design and modeling of automated rain sensing umbrella.

Holtz, J. Pulsewidth modulation-a survey. *IEEE transac- tions on Industrial Electronics*, 39(5):410–420, 1992.

Kulkarni, T. S. and Holalad, H. S. Semi-automatic rain wiper system. *International Journal of Emerging Tech- nology and Advanced Engineering ISSN*, pp. 2250–2459.

Mazidi, M. A., Mazidi, J. G., and McKinlay, R. D. *The 8051 microcontroller and embedded systems using assembly and C*. Dept. of Computer Science and Information Engi-neering National Cheng Kung . . . , 2005.

Monk, S. and Amos, D. *Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards*. McGraw- Hill Education, 2017.

Sachin, M. and Gaonkar, P. Design, implementation and control of a humanoid robot for obstacle avoidance using8051 microcontroller. *IOSR Journal of Electronics and Communication Engineering*, 5(5):40–50, 2013. Su, B. and Wang, L. Application of proteus virtual system modelling (vsm) in teaching of microcontroller. In *2010 International Conference on E-Health Networking Dig- ital Ecosystems and Technologies (EDT)*, volume 2, pp. 375–378. IEEE, 2010.