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AUTOMIZING CAN COMMUNICATION SYSTEM USING RASPBERRY-PI

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ABSTRACT

With the use of the most recent controllers, raspberry-pi and CAN controller, together with a feedback communication system to improve system performance, this project is intended to design and improve a commutation system for accurately controlling electrical characteristics. Additionally, controlling all of the data that was received from the system in the cloud is being done here using the example of an electric motor and lighting fixtures. The ability to store data on the cloud will be very beneficial for businesses and asset owners. The goal of this project is to combine the CAN bus with Raspberry-pi for numerous applications by providing the necessary futures.

I. INTRODUCTION

A CAN communication platform is included in the traction control unit TCU of today, enabling it to link with all accessories, such as the cluster, vehicle control system, and battery management system (BMS). The management of the vehicle network, which is used to flash programs, depends on CAN as well. This study's main objective is to assess how well the TCU's CAN protocol can automate, control, and acknowledge the status and mistakes associated with e-motor operations. Smart technology, which is also fuelled by cutting-edge ideas like artificial intelligence, is being embraced by the contemporary, fast-paced world. Numerous businesses, including the auto industry, can benefit from automation. Additionally, it is unutilized large-scale enterprises to monitor and regulate a range of electrical systems in different ways employing electronic boards that may perform several functions.

Proposed block diagram of this project

This project design divided into major section like Input block, Communication block, Output block and Cloud management

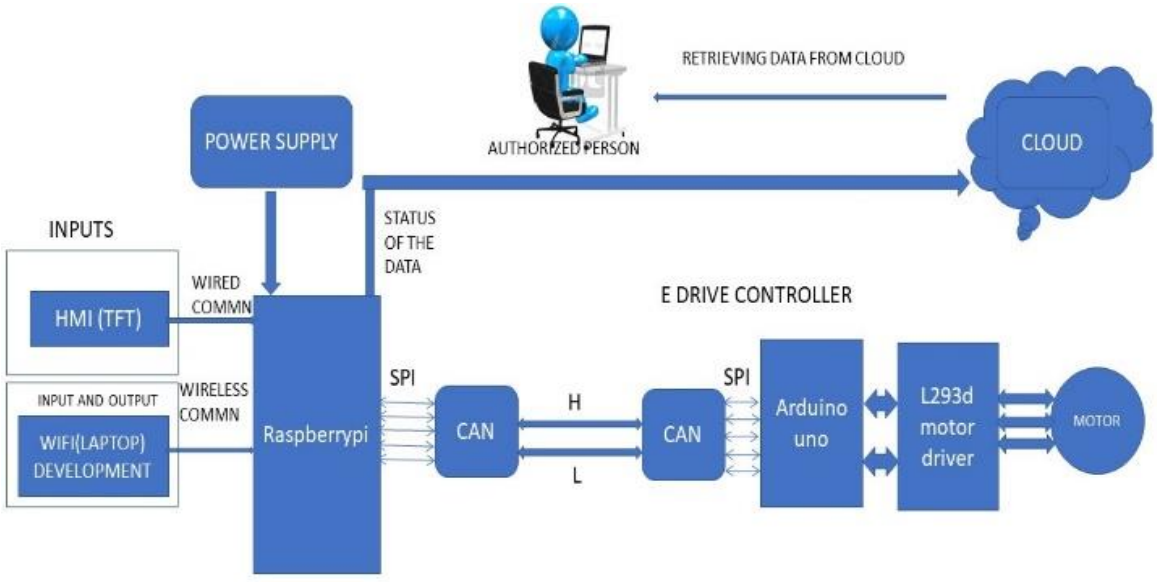

Fig 1: Block diagram of the project

Input block:

In this section we have the components those are laptop and TFT screen for the input purpose and raspberry pi is added in this section which is used to store and process the data. also, raspberry pi has been included in to communication block.

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Communication block:

As referred to the input block to CAN MCP2515 modules are used to perform transmit and receive function, the complete communication system is referred under CAN protocol. In this section the communication established between two CAN modules with help of SPI protocol with SPI protocol it receives and transmits the data to nodes.

Output block:

In this section components used are Arduino UNO, L293d motor controlled, DC motor and LCD display. Display shows the data which received from CAN. Motor runs based on CAN data.

Cloud management:

This section handles data management, Data includes status of the motor which collected by using sensors. The data been present in the cloud can be accessed by authorized person

II. LITERATURE SURVEY

This section explains literature survey done on the various research papers related to this project. A brief explanation of each paper is provided.

Implementation Of CAN Bus Communication To UART In LAPAN-A4 Satellite- Rommy Hartono, A Hadi Syafrudin, Wahyudi Hasbi, Rakhmad Yatim 2018 - In order to connect to SLIM4 over CAN Bus, this paper specializes in the layout and implementation of CAN utilising Microchip MCP and a microcontroller. MCP 2515 and MCP 2551, which appoint the SPI interface to expand the CAN Bus interface, are the CAN controller and CAN transceiver, respectively, used on this research's hardware architecture.

VANET primarily based totally overtake mishap preventive enhance street protection gadget, Aniket D. Sathe, Divya Singh, Tanmay Dalal, Vivek Deo Deshmukh 2016 - An overtaking twist of fate prevention gadget is created on this study. The gadget informs the motive force of the platoon to which their automobile belongs. The tool aids the motive force in information the rear automobile's overtaking behaviour.

The gadget additionally directs the motive force while it chooses to byskip the automobile in the front of it. The Road-Side Devices support persisted automobile touch for the duration of its carrier region. When a automobile is transferring throughout the variety of a roadside tool, it gets and transmits the vital facts thru an in-automobile module. Each In-Vehicle-Module executes a Decision set of rules to decide the the front and rear vehicles in relation to itself primarily based totally at the facts furnished through every automobile, that is received through Road-Side Devices of different vehicles.

Electric Vehicle Charging Communication Test-mattress following CHAdeMO Devika Anil P. Sivraj 2020 - In this study, a software program and hardware structure for CHAdeMO-primarily based totally records transmission between electric powered automobiles and electric powered car deliver device is presented (EVSE).

Rajesh Kannan Megalingam, Arjun Sahajan, Anandu Rajendra prasad, Sakthiprasad Kuttankulangara Manohara, Chennareddy Pavanth Kumar Reddy 2021. In this study, we propose a system wherein a robot arm's six actuator nodes, or stages of freedom (DOF), are related through the Controller Area Network (CAN) bus to create a communication community and obtain commands from a unmarried controller (Raspberry Pi). The host simulator's Gazebo simulator is used to generate a simulation environment, and Rviz is used to behaviour real time evaluation of the robot arm.

A joystick connected to the identical host PC supplies instructions to the robot arm thru the simulation. The not unusual place controller gets the place of every joint in relation to the command from the joystick through WIFI, and hardware the usage of the CAN shows a message receipt indicator.

Gao xian, Li lin-sheng -2020.- The body postpone and media get admission to postpone—the 2 number one additives of records postpone withinside the CAN network are mentioned via evaluation of the postpone composition of message transmission withinside the CAN bus. Frame duration and baud price each have an effect on how fast frames move. The body postpone and media get admission to postpone—the 2 number one additives of records postpone in the CAN network are mentioned via evaluation of the postpone composition of message transmission withinside the CAN bus. The body postpone is a feature of body duration and baud price, subsequently one of a-kind body systems and baud fees will bring about various body delays. It

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examines the body postpone in numerous scenarios the usage of longitudinal and latitudinal comparison. And the CAN protocol itself is the important thing wrongdoer in the back of the media get admission to dela

III. INTRODUCTION TO CAN

The introduction to CAN and its various types is covered in this section. Also summarized are the pin schematic and pin description. After a brief introduction to CAN, a flowchart is used to summarize the fundamentals of the data transfer frame and faults.

Device overview

Controller area network is known by the acronym CAN. CAN is a serial communication bus and industry standard that was created for communication even in challenging environments. It is typically utilized for communication between parts used in industrial and automotive applications. Various electronic devices, such as engine management system, active suspension, ABS, gear control, lighting control, air conditioning, airbag, central locking, etc., would be included in the components. Robert Bosch actually came up with this in the early 1980s. Due to the rising usage of electrical components and intricate wiring onboard, this technology became unavoidable. With CAN, it has gotten simpler and easier as there are more components, wirings, and interactions between them.

IV. CAN MCP2515

CAN Block diagram

The CAN module contains the CAN protocol engine as well as transmit and receive buffers, masks, and filters. the registers and control logics those are utilised to set up and operate the device. The SPI protocol block is present.

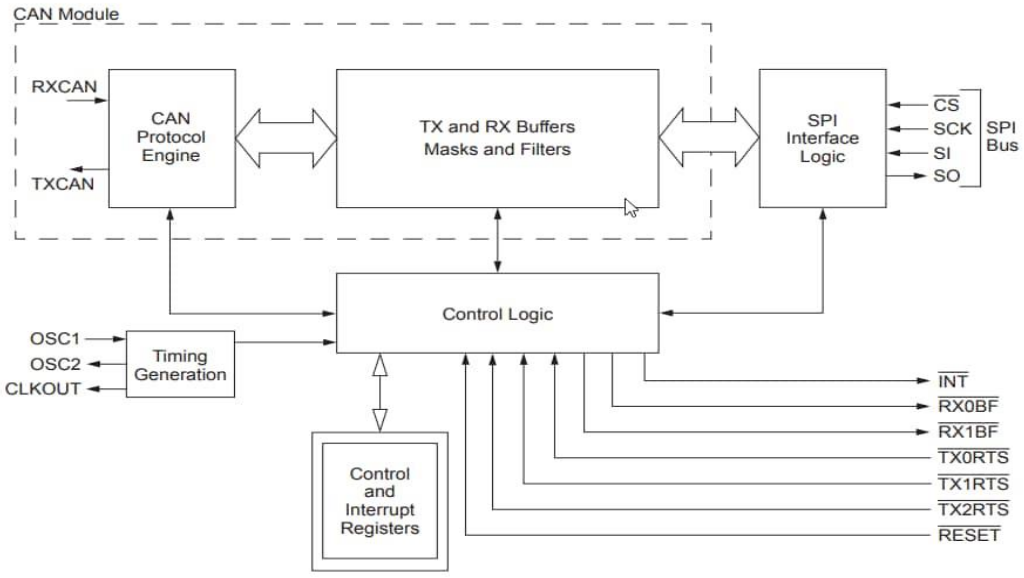

Fig 2: Block diagram of CAN

DATA frames

- Arbitration field - which is also called as Message identifier.
- control field - which defines the user defined functions.
- Data field - where actual data can be captured.
- CRC & ACK field apart from this each CAN message Must start with start of frame bit and End to End of frame bit
- SOF (start of frame) - indicates the start of the new frame on the network (1 bit).
- Standard data frame defines under CAN Specification 2.0A Contains 11-bit message identifier which is used for arbitration.
- Identifier - A message identifier sets the priority of the data frame.

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- RTR - Remote transmission request defines the frame type. Data frame or remote pair of 1bit
- IDE - bit in the control field is stand for identifier extension a dominant IDE bit indicates 11-bit Standard frame bit identifier and recessive IDE bit indicates 29 bit (frame) Extended fame identifier.
- DLC - Data length code (4 bit's) which defines length of the data in the data field.
- Data field - User defined Data (0 to 8 bytes) In the data field Maximum we can have data (0 to 8 -bytes) 4 bits are available in DLC to configure a number of bytes requited in a particular Message frame.
- CRC - (cyclic redundancy code) 15-bit CRC field which is used to detect any data correction during transmission the Sender will compute the CRC before sending the fame after receiving each receiver will compute the CRC again compare with this if the CRC does not match the receiver will generate the error frame
- After receiving is all the bytes from sender in CAN there is no separate packet sent.
- EOF - End of frame, frame ends with 7 conjugative recessive bits.

Standard Data frame

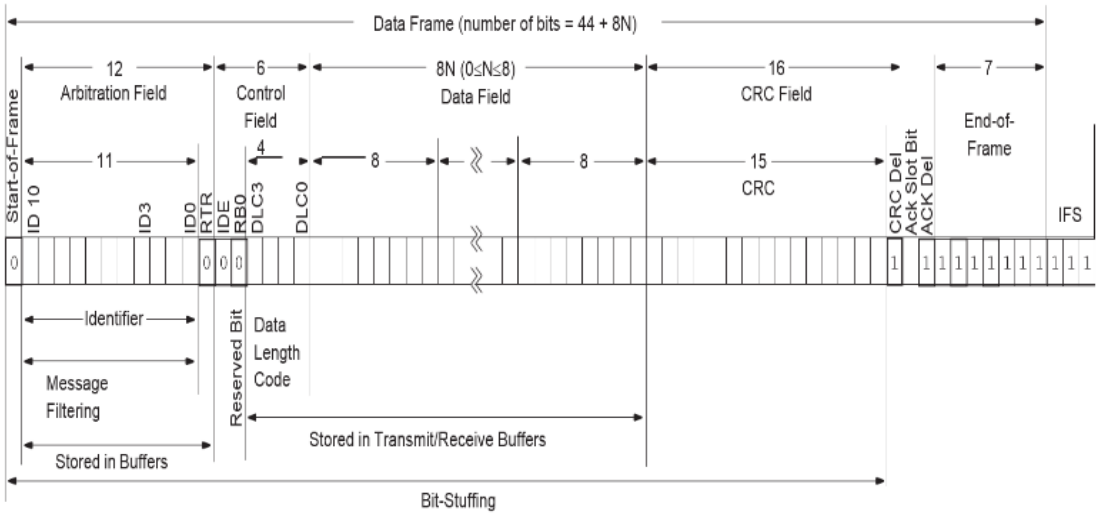

Fig 3: Standard data frame

CAN as a transmitter

Check to see if the bus is optimal after initialization is complete. If the bus is not ideal, recheck after waiting until it is free and send the message to all nodes. If the message is received by all nodes without any problems, check the bus's ideality once more; if not, throw away both the sent and received message. The message with the highest priority will be transmitted first in the arbitration, with the lowest message ID having the highest priority.

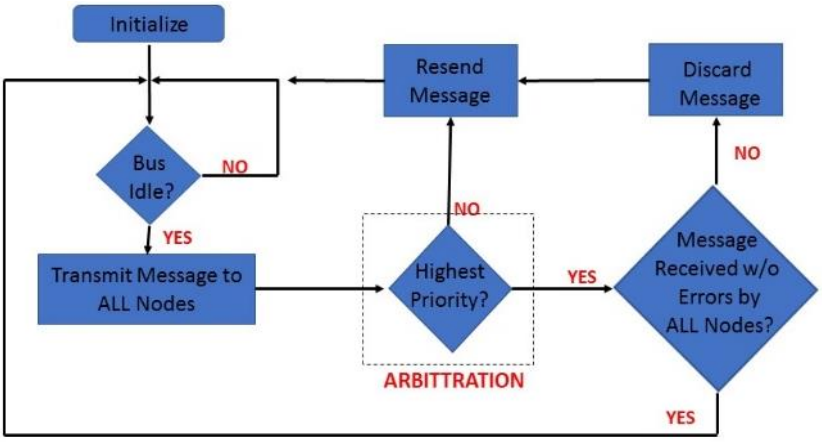

Fig 4: Flowchart for Transmitting function of CAN

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CAN as a receiver

Once startup is complete, the system waits for a message to be sent and, upon receiving one, checks to see if the recipient message contains any errors. If it does, the message is discarded by sending an error frame. If there are no errors, see if the message is phishing-related. Match discovered on filters and mask it solely for the message's identifier; if it matches, the message is transferred to the appropriate receiver buffer.

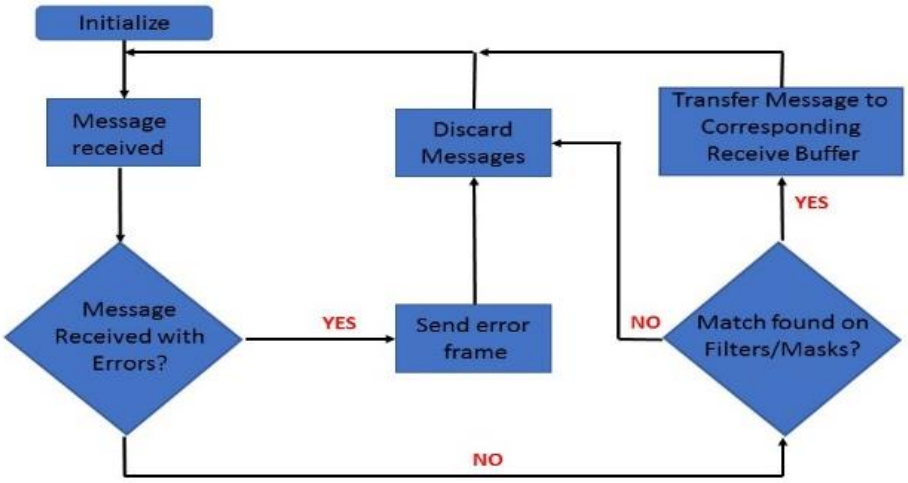

Fig 5: Flowchart for Receiving function of CAN

V. RASPBERRY-PI AND ARDUINO

RASPBERRY-PI

This chapter examines several uses for your Raspberry Pi, including utilising it as a media center, creating games with Scratch, and controlling electronics with Python. The Raspberry Pi's simplicity as a little general-purpose computer (which could be a little slower than you're used to for some desktop apps, but far better at some things than a standard PC) is what makes it so attractive.

RASPBERRY-PI 4B

The new Raspberry Pi 4 is a step up from older models in terms of speed and performance. We have created a fully integrated desktop experience for the first time. Whether you're editing documents, multitasking spreadsheets, multitasking the web, or creating a presentation, you'll find the experience to be fluid and very familiar—just on a smaller, more energy-efficient, and significantly more affordable machine.

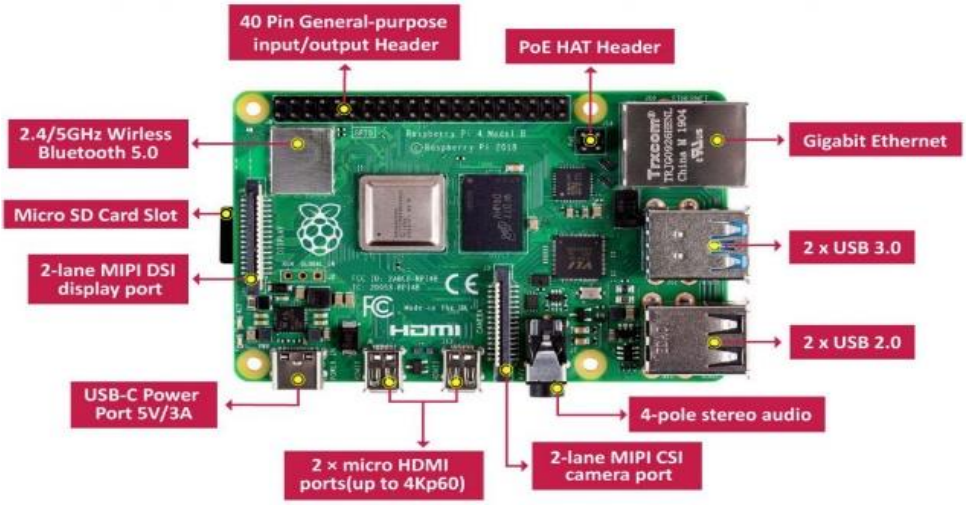

Fig 6: Raspberry-pi 4B model with peripheral details

Getting Started with the Raspberry Pi

Now that you have a fundamental understanding of how the Pi differs from other computing devices, it is time to get started. Remove your Pi from its protective anti-static bag before continuing with this chapter if you just

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got it. Then place it on a flat, non-conductive surface.

Setting up a Display

You must first connect a display to your Raspberry Pi before you can use it. Composite video, HDMI, and DSI video are the three different video outputs that the Pi supports. As mentioned in this section, composite video and HDMI video are readily available to end users, however DSI video needs some specialist hardware

Display Parallel Interface (DPI):

The GPIOs provide a common parallel RGB (DPI) interface. A secondary display can be supported by this up to 24-bit parallel interface. SD/SDIO Interface:

SDIO interface.

The SD card socket on the Pi4B supports 1.8V, DDR50 mode, with a maximum bandwidth of 50 Megabytes per second. Additionally, the GPIO pins offer a legacy

USB: The Pi4B features two type-A USB2 and two type-A USB3 connectors. A total of 1.1A maximum downstream USB current is allowed across the four sockets.

HDMI:

The Pi4B includes two micro-HDMI ports that can support resolutions up to 4Kp60 and CEC. They both support HDMI 2.0.

Arduino

Fig 7: Arduino UNO model

The Arduino UNO R3 is the ideal board for those who want to learn more about coding and electronics. The renowned ATmega328P and the ATMega 16U2 Processor are both included in this adaptable microcontroller.
The ATmega328P is the core of the Arduino UNO microcontroller board. Six of its analogue inputs can be used as PWM outputs, and it has a 16 MHz ceramic resonator, 14 digital input/output pins, a USB connector, a power jack, an ICSP header, and a reset button. Everything required to support the microcontroller is included; all that is required to get going is the insertion of a USB cable, an AC-to-DC adapter, or a battery. Without being unduly anxious that you'll make a mistake, you can experiment with your UNO; in the worst case, you can replace the chip for a few dollars and start over.

L293D

A 16-pin motor driver IC called the L293D is capable of driving two DC motors concurrently and in either direction. At pin 8! voltages between 4.5 V and 36 V, the L293D can generate bidirectional driving currents up to 600 mA (per channel). Toy motors, which are tiny dc motors, can be managed by it. The L293D is an H-Bridge with two possible outputs. In other words, you can connect two objects to it and control how much current flows through them both. Current greater than 250mA is needed for typical DC gear head motors. The 555 timer and ATmega16 microcontroller are only two examples of the many integrated circuits available. However, the IC 74 series cannot deliver this amount of electricity

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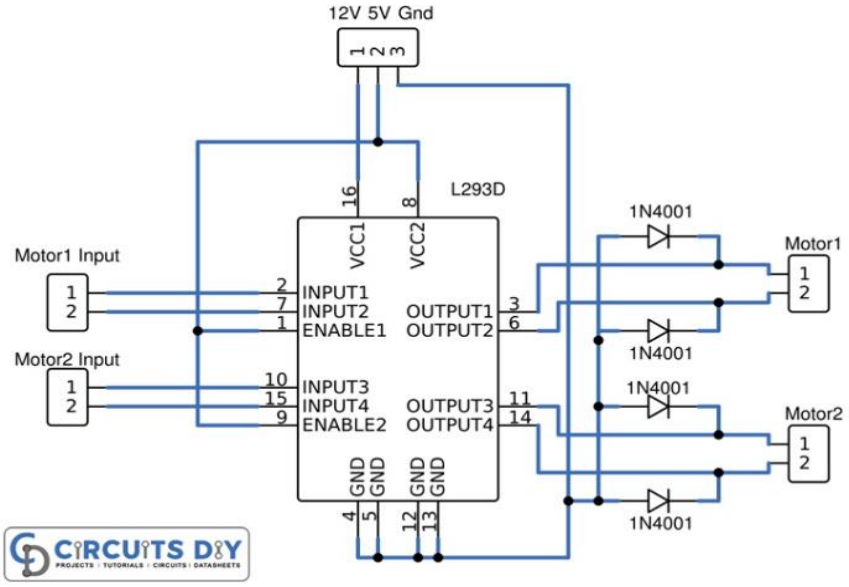

Fig 8: H-bridge for two motors

LCD DISPLAY

Nowadays, we commonly use electronics with LCD screens, such as CD and DVD players, digital watches, PCs, etc. They are frequently used in substitute of CRTs in the screen business. Cathode Ray Tubes (CRTs) are heavier and bulkier than LCDs, and therefore use a lot more electricity. These gadgets are smaller and use a remarkably small amount of power. The LCD 162 works on the principle that it prevents light from escaping rather than allowing it to do so. This page provides a general overview of the pin configuration and functionality of the LCD 16X2.

VI. DESIGN & WORKING

CONFIGURATION OF RASPBERRY-PI

- Connect Cable Search your raspberry pi to a Ethernet click start menu and for putty
- Open command prompt and Enter the Raspberry pi password user name: pi password: Raspberry
- Enter sudo raspi-config now raspberry-pi software configuration tool opens in that' select Interface option

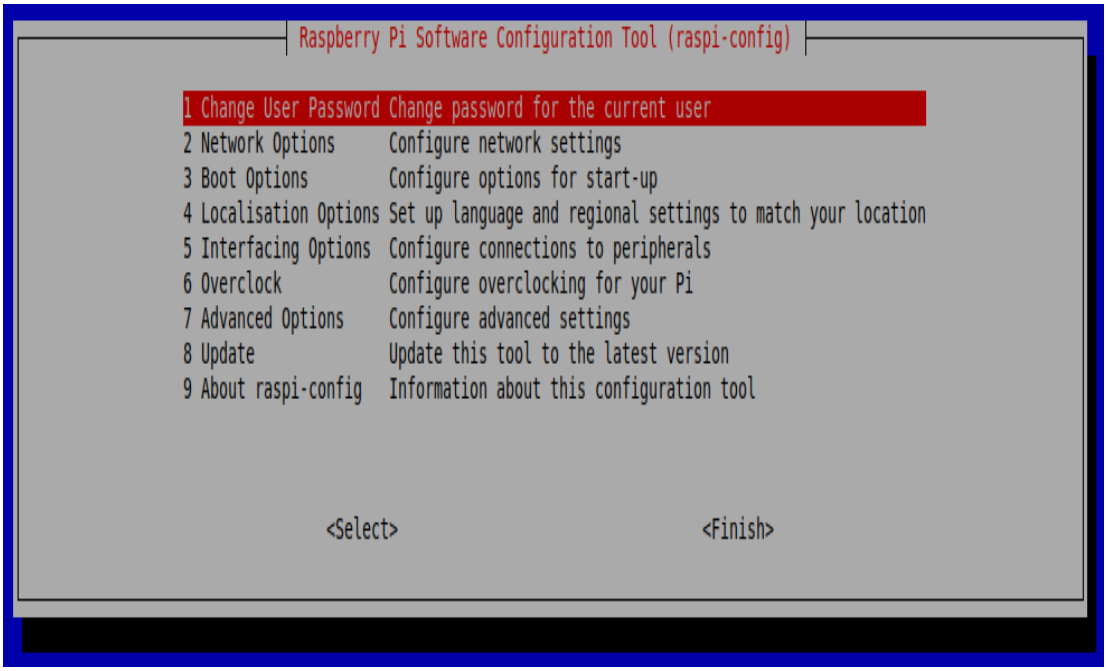

Fig 9: Raspi-config tool

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- Select P3 VNC and press Enter now "Select confirmation VNC Viewer activated.
- Find the IP address
- To find the op adders open the comm and prompt, enter the command ipconfig Make note of the IP address 192.168.1.2 now close putty and disconnect the Ethernet Cable.
- After this configuration you need to download "the UNC Viewer once the downloaded Enter the IP address of Raspberry pi 198.168.1.2. and press outer.

Enter the User name as: pi

- Password: Raspberry pi
- Now we are connected remotely, with the VNC Viewer.

Fig 10: Raspberry-pi OS screen

RASPBERRY-PI TO CAN

Raspberry pi to CAN mcp2515

3.3V (Physical Pin 1) - Vcc

GND (Physical Pin 6) - GND

CE0 (Physical Pin 24) - CS

MISO (Physical Pin 21) - SO

MOSI (Physical Pin 19) - SI

SCLK (Physical Pin 23) - SCK

GPIO-BCM-12 (Physical Pin 32) - INT

ARDUINO TO CAN-MCP2515

Arduino to CAN MCP-2515 connection diagram

Arduino UNO to CAN module

5V -Vcc

GND - GND

Pin 13 - SCK

Pin 12 - SO

Pin 11 - SI

Pin 10 – CS

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CAN-CAN PROTOCOL

A standard called the CAN protocol was developed to make it possible for a microcontroller to communicate with other devices without a host computer. The CAN protocol differs from other communication protocols due to its broadcast bus type.

SPI protocol uses 4 wires to communicate

1 MISO - master input slave output it is used to send the from the slave to master.

1 MOSI -master output slave input it is used to send the data master to the slave.

2 SCK – serial clock used to clock signal.

3 SS/CS – slave select/ chip select it is used by the master to send the data to slave.

VII. RESULT

The primary goal of this system is to use CAN MCP2515 modules to establish communication between two controllers. Therefore, we are uploading a CSV file here. To do a specific action, we need to submit the appropriate file.

When we run the program, it automatically displays a GUI window with Start and Stop buttons for the CAN protocol.

Project setup:

We can see the project setup using all described components and connecting patch chords

Results obtained from the different stages of project

GUI window

GUI window help us to feed input commands to start and stop operations for the motor connected at the destination GUI window is the result of input device.

CAN Data at the transmitter side

When we select particular file among the loaded file, and press Start button in GUI window, it begins reading the data in a column-by-column fashion and transmits it to the CAN in 8-bit length with a delay of 10ms.as a result of data reading screen shows the selected file data

CAN data at receiver side

At the receiver side, LCD is connected to the Arduino, it receives the continuous data from the CAN transmitter and displays the received data along with an CAN identifier. Below figure shows the respected output.

Motor running status

The DC motor is controlled by L293d motor controller when controller reaches more than 100 values the motor starts run when below threshold values the motor should be OFF for reference purpose shown the motor running based on CAN data.

VIII. CONCLUSION

We have successfully designed an Arduino Raspberry board based on the CAN protocol, we have also created the basis for further use of these boards for automotive and industrial applications. This MCP2515 board eliminates the complexity of the connection between different controllers, as this complex design and the use of multiple peripherals can be reduced, From the test results, it can be concluded that the best way to collect data from CSV file using MCP2515 CAN tag due to data synchronization for each data packet frame of CAN bus data collector, can be concluded that using the MCP 2515 CAN bus would increase the system performance due to the rapid collection of data packets. It is easier to split data into sub packages than in the two-byte data conversion method. Then, more accurate CAN bus data conversion using CAN bus MCP2515 and CAN 2.0B showed that CAN2.0B has lower average latency than MCP2515 from this study, MCP2515 CAN has been shown to have less loss more data. In this article, we have explained about the CAN protocol and its vulnerabilities. Although CAN is the most widely used vehicle communication protocol, we have summarized the main CAN MCP2515 specifications compared to others in the literature and specifications and benefits. In general, the MCP 2515 relies on CAN to transmit and receive messages between multiple devices. For this reason, it serves as a convenient communication protocol for many industrial and automotive applications. Not only that, it also

offers other features including built-in high-speed IC TJA1050 and IC MCP 2515. You can even allow this device to communicate with the microcontroller via the SPI interface. However, you will need two CAN bus modules to achieve 1MB/s communication.

IX. FUTURE SCOPE

The needs of society today are focusing on automation and intelligent technologies that produce results with a high degree of precision, which were previously not entirely met by control boards in industries. The system design was bulky and expensive, and the results were occasionally not accurate enough for substantial work. The components, such as separate controllers used for many operations in a single system, were the cause of the system's bulkiness. To solve this issue, advanced applications were added, and CAN was introduced and used as a single controller for multiple activities.

Due to their effectiveness in real-time applications, these types of controllers have become increasingly important in recent years. As an illustration, we can look at the CAN bus applications utilized by the automotive industry's most automated vehicle, the TESLA, to generate a variety of intriguing possibilities from the ignition of the automobile to each and every activity. The CAN bus of a Tesla car can provide some intriguing data regarding the condition of various car parts.

CAN is set to maintain its broad use as a go-to dependable communications protocol in industrial automation and the automotive industry, even as complexity keeps rising with linked automobiles and increasingly sophisticated robotics. Industrial Ethernet provides faster speeds however it is also less reliable and consistent than CAN. However, with the increased bandwidth of CAN FD and the easier, more effective CAN-to-Ethernet gateways, the most convincing approach would be combining the benefits of the two protocols to create a sophisticated, complimentary system that lets each system concentrate on its strongest aspects.

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