International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

RS232 Over Air Using IoT

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Abstract - *RS232 is a well-known form of serial communication protocol. After 6 decades still used in 2021; it is used for connecting various day today as well as industrial & commercial devices. Its cable length is limited to 50 feet (15meters). When cable length is greater than 50 feet then it would not establish proper communication. There are chances of data loss or inappropriate communication, so the main limitation of the RS232 protocol is its cable length. To overcome this problem RS232 over the air is designed using IoT technology. To implement this solution we are using a microcontroller IoT board and ICMax232. There will be two sections in this project: Transmitter and Receiver. On the transmitter side; command by DTE in the form of RS232 signal will upconvert into TTL logic using ICmax232 and then the rs232 data will be given to NodeMCU. The received data will get transmitted to the IoT platform database. On the Receiver side; data will be fetched from the database via the internet by NodeMCU and then it will down convert to rs232 signal using ICmax232 and communication will get established.*

***Key Words*: RS232, Serial Communication, IoT, ICMax232, NodeMCU.**

1. INTRODUCTION

The Internet of Things (IoT) is an emerging technology that enables the communication between electronic peripherals through the internet to facilitate our lives. Nowadays everything is going wireless and IoT is progressively becoming an important aspect of our life that can be sensed everywhere around us. RS232 is a standard protocol used for serial communication, by bridging both technologies will overcome the limitations of RS232 and able to wirelessly exchange data between peripherals.

2. LITERATURE REVIEW

2.1. RS-232 Communications:

In electronics & telecommunication industry, RS232 is used till date. It uses serial communication, where bit data is sent at a time along a single data line. The cables used in RS232 system are economical and even we can take from unutilized network cables system. The standard does not define a maximum cable length but allows up to 15 meters at 19.2 kHz. RS232 is a Serial Asynchronous Communication Interface Adapter device introduced by electronic industries adapter, RS is short for Recommended Standard. [1] The original RS–232 standard was defined in 1962. It was defined before TTL logic and hence, it is not unexpected that RS232 does not use TTL specific 5v and GND logic levels. The logic'1'in RS232 is described as being in the voltage range of -15v to -3v and logic '0'is described as the voltage range of +3v to +15v that is low level voltage is logic'1'and high level voltage is logic '0'. Most systems designed today do not operate using RS–232 voltage levels. So for that level conversion is necessary to implement RS232 communication. Level conversion is performed by special RS232 IC's. Typically, the logic '1'in RS232 is will be -12v and logic'0'will be +12v .Historically, logic '1'(-15v to -3v) is referred to as Marking and logic '0'(+3v to +15v) is referred to as Spacing. A limitation to discuss concerning RS 232 communication is cable length. As we have already seen, the cable length specification that was once included in the RS–232 standard has been replaced by a maximum load capacitance specification of 2500 pF. If a extended cable length is required, the user would wish to seek out a cable with a smaller mutual capacitance. Modem applications are one among the foremost popular uses for the RS–232 standard. The voltage levels of RS232 are very different from most of the system designed today. Hence , we need level converter of some sorts to implement RS232 interface. To implement our work we are using level converter IC MAX232. It takes signals and generate a TTL level voltages. If we take example; the PC is the DTE and the modem is the DCE. Communication between each PC and its associated modem is accomplished using the RS–232 standard. Communication between the two modems is accomplished via telecommunication. [2]

2.2 Microcontroller:

NodeMCU is an open-source platform, its hardware design is open for edit, modify or build. NodeMCU Kit consist of ESP8266 wifi enabled chip. It is developed by Espressif systems with TCP/IP protocol. IoT microcontroller features low-power processors which support various programming environments, collect sensor data using firmware and transfer it to a local or cloud-based server. So we are using NodeMCU and it has an inbuilt ESP8266 wifi module that is suitable for the implementation of our system. [3]

2.3 ICMAX232:

Max 232 is an IC that converts TTL(Transistor-Transistor Logic) logic level signal into its equivalent RS-232 level signal and Rs-232 level to its equivalent TTL level signal. RS232 signal level requirement are from +3v to +12v(mark) and -3 to -12v(space) , though very few devices only generate 3v most are 5v and above. We need a circuit to shift voltage levels from whatever logic level circuit to drive an RS232 signal on wire, and this what device like MAX232 do. Now if we need to transfer data from microcontroller to PC (Personal computer) we'd like to convert data from TTL to RS232 level and if we would like to send data from PC to microcontroller we've to convert data from RS232 to TTL. Max-232 is a solution to this problem. Prototyping Hardware or Development kits are breadboard-friendly and optimized for expandability, modularity, and simple use. [4]

3. DESIGN AND ARCHITECTURE

To perform several tasks we use different components here. As shown in fig 3.1 Initially we have an RS232 signal by DTE(Data Terminal Equipment) with High voltage fluctuations as mentioned in the literature review which is not compatible with to microcontroller to the processor that's why we need to convert RS232 to TTL logic level for doing this task an IC is used called IC MAX232. It converts RS232 Signal with high Voltage Fluctuations to TTL logic signal. RX pin of MAX232 Will get connected to TX Pin of microcontroller and vice versa. Data will get received by the microcontroller. ESP8266 WIFI Module is interfaced with controller will help the controller to connect internet. when the controller connected to the internet as per its program it will be connected to one of the IoT platforms and with the Help of Write API key pasted in the program, it will transmit data to the IoT platform database(cloud) continuously. At the Receiver Side, there is DCE (Data Communication Equipment) where data/command should deliver. As shown in Fig. 3.2 same components are used. Esp8266 is interfaced to the microcontroller; it connects the controller to the internet and with the help of read API Key pasted in the controllers' program, it will read data sent by the receiver side at IoT Cloud. Received Data is in the form of TTL logic to retain signal RS232 . We need to down convert it to RS232 signal with voltage fluctuations with ± 5 V to ± 15 V this job will be done by IC MAX232 and we get RS232 signal as an output at receiver.

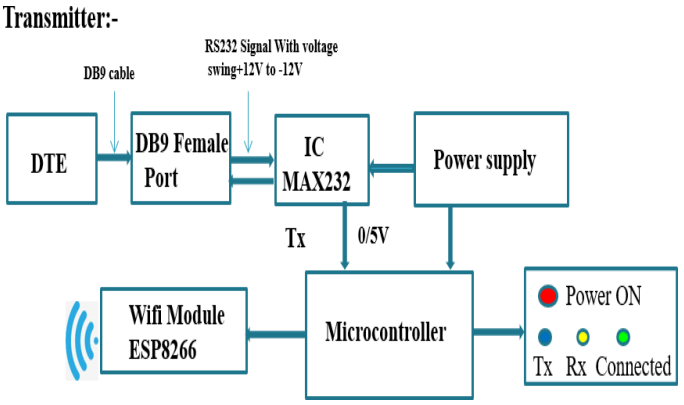


Fig 3.1 Block Diagram Of Transmitter System

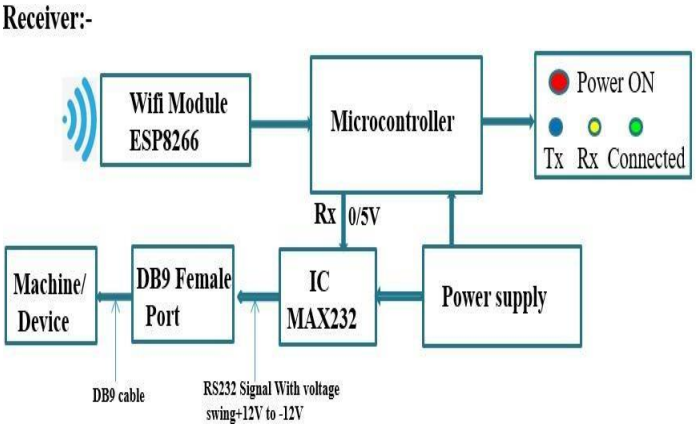


Fig 3.2 Block Diagram Of Receiver System

The system components are as follows:

3.1 NodeMCU: NodeMCU is a low-cost open-source IoT platform. It initially included firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware which was supported the ESP-12 module. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of non-volatile storage to store data and programs. NodeMCU are often powered employing a Micro USB jack and VIN pin (External Supply Pin). Power requirement to this board is 5v.

Fig 3.1 NodeMCU

3.2 ICMAX232: The MAX232 is an microcircuit that converts signals from a RS-232 interface to signals suitable to be utilized in TTL-compatible digital logic circuits. The drivers provide RS232 voltage level outputs (about ±7.5 volts) from a single 5-volt supply by on-chip charge pumps and external capacitors. This makes it useful for implementing RS232 in devices that otherwise don't need the opposite voltages. The receivers reduce RS232 inputs, which may be as high as ±25 volts, to standard 5 volt TTL levels. The power requirement is 5v.

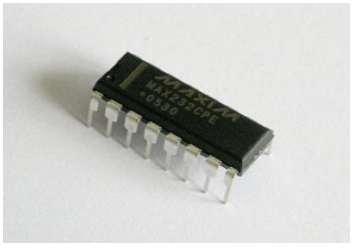


Fig 3.2 ICMAX232

3.3 Data Terminal Equipment(DTE): It is a computer system that is used to send operating commands to devices that are connected to it via Rs232 protocol**.** A DTE is that the functional unit of a knowledge station that is a knowledge source and provides for the data communication control operation to be performed by the link protocol.

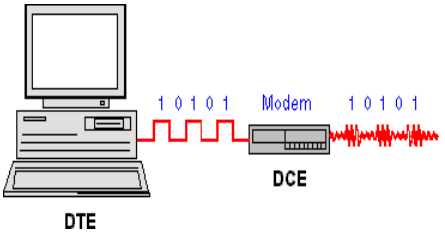


Fig 3.3 DTE & DCE

3.4 DB9 Serial Cable: A serial cable is used to transfer information between two devices using a serial communication protocol. The form of connectors depends on the actual interface used. A cable wired for connecting two DTEs directly is understood as a null- modem cable. Here it will connect DTE to our project model.

Fig 3.4 DB9 Serial Cable

3.5 LED Panel: This section in our project is to indicate the ongoing operation. There are 4 LEDs over there to indicate respective operations:

1. RED LED: To Indicate Power ON status when it turns on.
2. Green LED: It will indicate connected status between transmitter and receiver when it turns on.
3. Blue: It Will Keeps On Blinking While Transmitting operation is going on
4. Yellow: It Will Keeps On Blinking While Receiving Operation Is going On.

3.6 Power Supply: A 5V regulated power supply is incorporated into our project.

4. ALOGRITHM

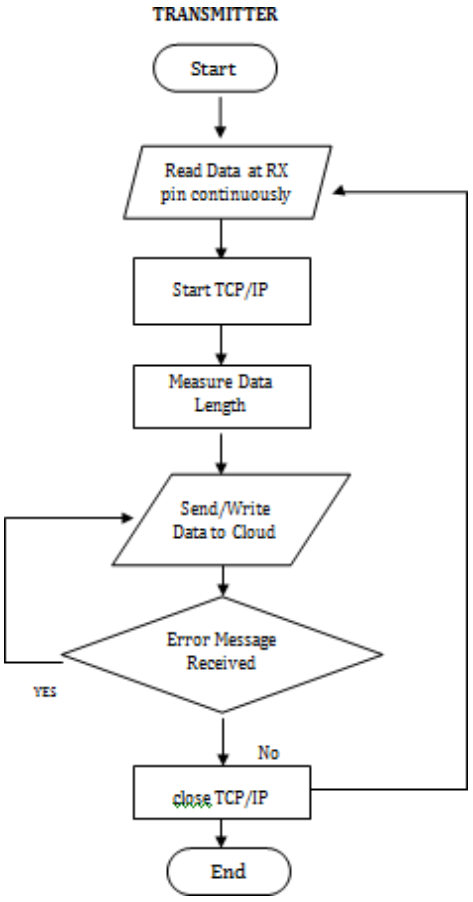
➢ **Transmitter**:

1. Read data from max232.
2. Start TCP/IP.
3. Measure data length.
4. Send/Write data to the cloud using a write API key.
5. Wait for acknowledgement or error message from the receiver side.
6. Data gets stored on a cloud database.
7. Go to step 1.

➢ **Receiver**:

1. Read data from the cloud using the Read API key.
2. Write data on the pin connected to max232 input.
3. Go to step1.

5. FLOWCHART



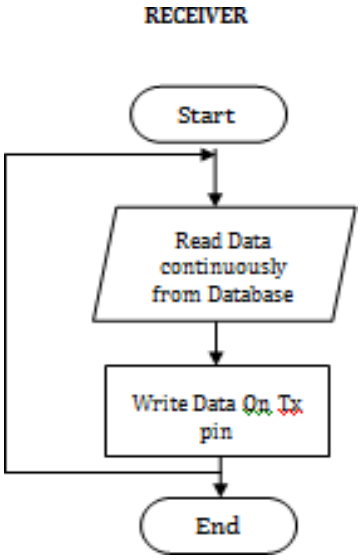


Fig 5.1 Flowchart of the system

6. CONCLUSIONS

The proposed approach of the design of the RS232 over Air using IoT is a good solution to provide wireless connectivity. As we studied RS232 is a decades-old communication protocol still it is popular and used in today's industry. We are designing this product to make it more flexible and versatile. Our product will bridge decades-old communication protocol with IOT technology and will provide wireless remote connectivity between DTE & DCE's.

7. REFERENCES

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