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Varicose Veins Patient Monitoring and Automated Treatment

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Abstract: *This paper presents a home based automated temporary treatment for patient healthcare to be made easier. The proposed system consists of a wearable device, detection sensors, and coin motor. Varicose veins are veins that are twisted and bulging. Varicose veins can form near the surface of the skin (superficial veins). Varicose veins most commonly affect the veins in the legs. This is because standing and walking increase the pressure in the veins of the lower body. In this project, a rehabilitation monitoring and exercise device. 5+1 thermistors are used where the former is for the lower body and the latter is for the upper body to keep track of the temperature. Comparing the temperatures of the lower body as well as the upper body and with the detection of force in the legs will activate the motor to give in the exercise to subtle pain and the block of blood in the nerves. The signal acquired from the thermistors and force motor is processed by Arduino using ZigBee for varicose pain detection. When the system was running, it was able to identify a three-degree difference in force and temperature and successfully install the coin motor. Patients will be able to receive rapid temporary therapy and will not have to hurry to hospitals if the rehabilitation system is implemented.*

Keywords: Varicose Veins; Automated Temporary Treatment; Arduino; ZigBee; Rehabilitation System

I. INTRODUCTION

The doctor evaluates whether there are lesions in the human body, as well as classifies and diagnoses the lesions, using diagnostic medical images. As a result, medical image classification and recognition may now be done automatically. It drew a lot of interest. Varicose veins in the lower extremities have been closely related to endothelial cells from the onset of vascular inflammatory disorders. We discovered that 50 percent of random adult body x-ray samples were 55-64 years old, 83 percent were male, and 87 percent were female [1]. This study proposes a varicose vein detection algorithm based on the lower extremities in order to automate the classification and detection of varicose veins in the legs. Regular and proper exercise can help patients who have had surgery lessen discomfort and perhaps save their lives [2]. MSDCNN stands for multi- scale deep learning and photographs of vascular endothelial cell inflammation. According to a study conducted by Thomas K. et al., 76 percent of patients who completed a home exercise programme experienced considerable pain alleviation and enhanced joint mobility [3]. First, we took pictures of vascular endothelial cells in both varicose vein sufferers and healthy people. Second, many convolutional layers are used to extract multi-scale properties of vascular endothelial cell images[4]. The MFM activation function is then used instead of the ReLU activation function to create a competitive process that extracts more compact features while lowering network layer parameters [5]. Finally, to simplify network parameters even more, the network uses a 3 3 convolution kernel for network feature extraction and a 1 1 convolution kernel for dimensionality reduction. Because it is not tailored for varied levels of gravity, the use of this device is confined to a specific group of patients [6, 9]. Search According to Thomas K. et al., 76 percent of patients who followed a home exercise programme experienced significant pain reduction [8]. According to the experimental results [6, the network offers great recognition accuracy, rapid running speed, minimal network parameters, and is suitable for small-embedded devices. Overall, physical activity recognition is critical for patients to manage proper exercise and has prompted recovery [7,11].

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1.1 Scope of the Project

The project's technology advancements include varicose veins patient monitoring and automated treatment, with the goal of providing a temporary solution for varicose veins patients to improve blood circulation and normalisation.

1.2 Existing System

In the current system, a separate individual examines the patient and administers treatment. A medical assistant is required whenever a patient requires care.

1.3 Existing-System Disadvantages

There is no automated mechanism for administering therapy, and the expense of treatment is significant**.** The treatment to Varicose veins sudden pain from level 2 are physiotherapy which the patient will not be able to get done when required. Moreover, they will have to rush to the hospital to subsidise the pain that is caused by the sudden strain on the veins. This is an added responsibility which cannot be done all the time.

1.4 Proposed System

Varicose veins patient monitoring and automated therapy are among the project's technological developments, with the purpose of offering a temporary solution for varicose veins patients to improve blood circulation and normalisation.

1.5 Proposed-System Advantages:

The project's technology innovations include varicose veins patient monitoring and automated therapy, with the goal of providing a temporary solution for varicose veins patients to enhance blood circulation and normalise their veins. This will result in immediate temporary treatment to the patient which is reduce the pain easing the patient. They would not have the need to rush to the near hospital or their physiotherapist. This will also make them independent as they don't have to rely on any medical assistance for further treatment. This also decreases the expensive bills to be paid to their respective therapist. Wearing clothing that is too tight can limit blood flow. Wearing loose-fitting garments that do not limit blood flow to the lower body may promote circulation.

II. Project Methodology

While there are several non-invasive procedures for measuring arterial blood pressure, venous blood pressure (VBP), which is important for monitoring intravascular volume status, is still invasive and is mainly performed on seriously ill patients. While there are various non- invasive ways to measure arterial blood pressure, venous blood pressure (VBP), which is critical for monitoring intravascular volume status, is still invasive and only done on seriously ill patients.

In this project, we used an Arduino UNO microcontroller, which acts as the brain of the system and holds all of the software. In this system, the thermistor is used to determine the body temperature. It has two points of attachment to the patient's body. As a result, one is linked to the chest, while the other is linked to the leg position. The ZIGBEE acts as a communication tool. The ZIGBEE delivers information to the receiver if one of the thermistor detects a change in leg position. The vibration motor starts up when ZIGBEE receives data from the transmitter and massages the patients. An LCD displays all of the information.

This study's primary purpose is to provide temporary relief from varicose veins. With time, the temperature of the thermistor used to diagnose varicose veins rises. The thermistor will be recognised as a result. At that point, the ZigBee will be dispatched. The thermistor's signal will be received by the ZigBee receiver, and the vibration motor will vibrate and rectify the varicose veins.

2.1 Hardware System:

A. Arduino

Arduino is an open-source, low-cost electronics platform featuring basic hardware and software. Arduino boards can translate inputs like light from a sensor, a finger on a button, or a tweet into outputs like turning on an LED, starting a motor, or publishing anything online. You can command the board's microcontroller to do something by sending it a set of instructions. The Arduino software is straightforward to use for beginners. Expert users will find it customizable to their

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needs. It works on Mac, Windows, and Linux systems. Teachers and students use it to build low-cost scientific equipment, demonstrate chemistry and physics concepts, and begin learning programming and robotics. Interactive prototypes are created by designers and architects, while musicians and artists use it to construct installations and try out new instruments. Many of the products on display at the Maker Faire, for example, are made with it by makers. Arduino is a great way to pick up new skills. Anyone can begin tinkering by following the step-by-step instructions in a kit or exchanging ideas with other Arduino members online.

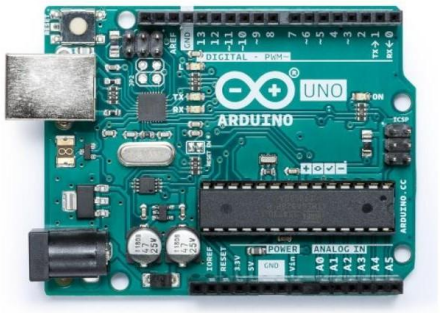

Figure 1: Arduino Uno REV3

The ATmega328P microprocessor is used in the Arduino Uno microcontroller board (datasheet). On the board, there are 14 digital input/output pins (six of which are PWM outputs), six analogue inputs, a 16 MHz quartz crystal, a USB connection, a power connector, an ICSP header, and a reset button. It includes everything you'll need to get started with the microcontroller, including a USB cable to connect it to a computer or an AC-to-DC converter or battery to power it. You can play about with your UNO without worrying about making a mistake; if something goes wrong, you can replace the chip for a few dollars.

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm

Figure 2: Arduino Uno Specifications

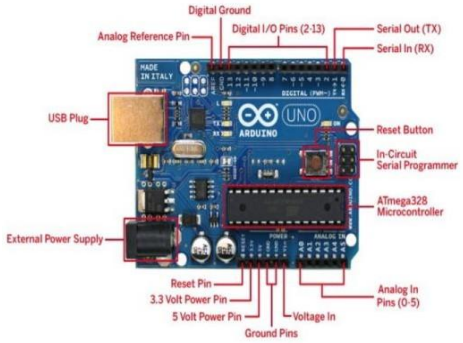

Figure 3: Arduino Uno parts

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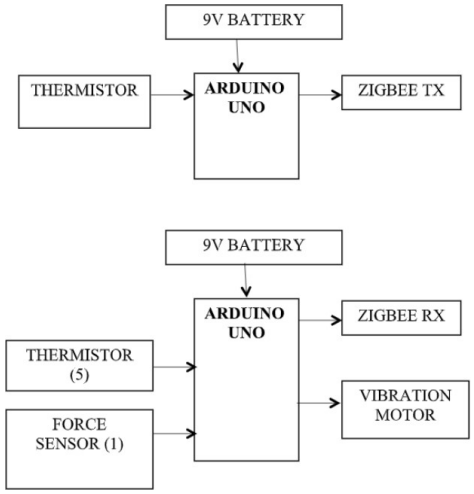

Figure 4: Arduino block diagram

Each of the Uno's 14 digital pins can be used as an input or output using the pinMode(), digitalWrite(), and digitalRead() methods. They are 5 volts powered. Each pin has an inbuilt 20-50k ohm pull-up resistor (by default unconnected) and can deliver or receive 20 mA as a recommended operational state. A 40mA restriction on any I/O pin must not be exceeded to avoid irreversible harm to the microcontroller.

B. 9V Battery

The nine-volt battery, also called a 9-volt battery, was a common size of battery used in early transistor radios. It has a rectangular prism shape with rounded sides and a polarised snap connector at the top. This is used in smoke detectors, gas detectors, clocks, walkie-talkies, electric guitars, and effects units.

Nine-volt battery forms include primary carbon-zinc and alkaline chemistry, primary lithium iron disulphide, and rechargeable nickel-cadmium, nickel-metal hydride, and lithium-ion batteries. These types of mercury-oxide batteries haven't been developed in a long time due to the mercury content.

C. Thermistor

A thermistor is a type of resistor that is far more temperature sensitive than regular resistors. The words thermal and resistor are combined to form the phrase. Thermocouples are commonly used in inrush current limiters, temperature sensors (typically with a negative temperature coefficient or NTC type), self-resetting overcurrent protectors, and self-regulating heating components (typically with a positive temperature coefficient or PTC type). The probe type determines the working temperature range of a thermistor, which is typically between 100 °C (148 °F) and 300 °C (572 °F). Thermistors are classified into two groups based on the materials they are made of:

In NTC thermistors, resistance decreases as temperature rises, owing to an increase in conduction electrons pushed up by thermal agitation from the valence band. In series with a circuit, an NTC is commonly used as a temperature sensor or as an inrush current limiter.

In PTC thermistors, resistance rises as temperature rises due to increased thermal lattice agitations, particularly those induced by impurities and imperfections. PTC thermistors are frequently used in series with a circuit as resettable fuses to protect against overcurrent situations.

Powered PTC thermistors have a range of uses due to their dynamics. When the thermistor is first connected to a voltage source, a large current corresponding to the low, cold resistance flows, but as the thermistor self-heats, the current decreases until a limiting current (and associated peak device temperature) is attained. The current-limiting effect can be used instead of a fuse. In the degaussing circuits of many CRT screens and TVs, a suitably selected thermistor is connected in series with the degaussing coil. As a result, the current gradually diminishes, providing a superior degaussing effect. In some of these degaussing circuits, auxiliary heating sources are employed to further heat the thermistor (and therefore lower the generated current).

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D. ZIGBEE:

The resistance of Force Sensing Resistors (FSR) diminishes as the force applied to the active surface rises. The sensitivity of its force has been fine-tuned for use in human- machine interfaces. Although they have some similarities, FSRs are not the same as load cells or strain gauges. FSRs do not allow for precise measurements.

The resistance of an FSR is determined by the pressure applied to the sensing surface. The less resistance there is, the more pressure you apply. The resistance range is exceptionally broad: from less than 10 M (no pressure) to more than 200 M (high pressure) (max pressure). The majority of FSRs can detect forces ranging from 100 g to 10 kg.

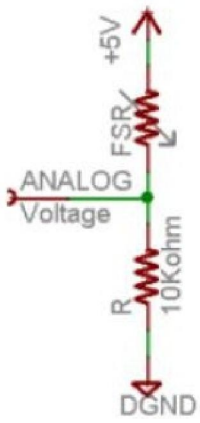

Figure 5: ZigBee Circuit diagram

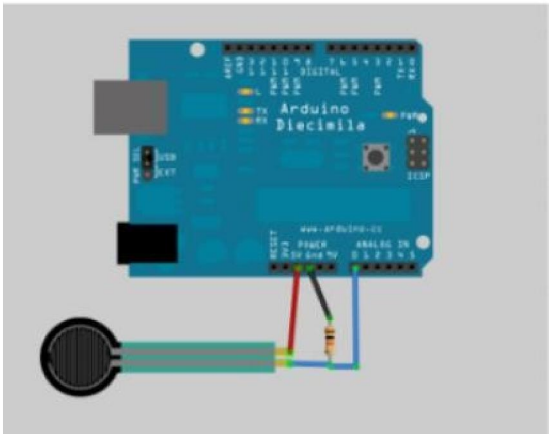

Figure 6: ZigBee module with Arduino

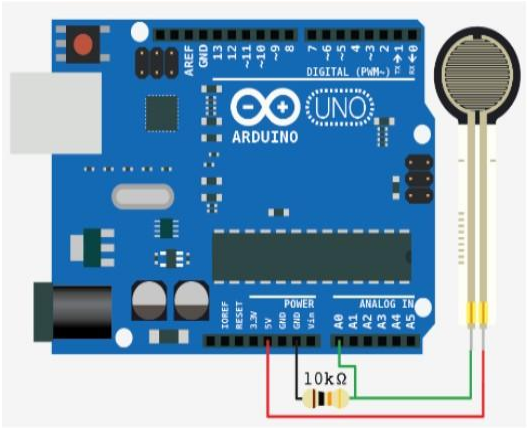

Figure 7: ZigBee module with Arduino Architecture

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E. Coin Vibrator Motor

Precision Microdrives currently produces coin vibration motors, also known as shaftless or pancake vibrator motors, in diameters ranging from 8mm to 12mm for our Pico Vibe line. Pancake motors are compact and simple to operate. They can be installed using a permanent self-adhesive mounting method and can be incorporated into a variety of designs because they have no moving parts on the outside.

The coin shape may be easily moulded into the enclosures for our shaftless vibration motors. In our collection, we have both leaded and spring and pad mountable coin motors. As with all of our vibration motors, we are happy to quote for changes to the base design, such as lead length and connections.

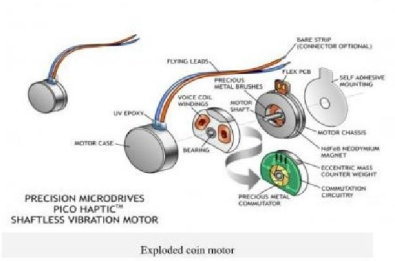

Figure 8: Exploded coin motor

2.2 Software System

A. Embedded C

In the software business, embedded C is the most extensively used programming language for constructing electrical gadgets. Each processor in an electronic system is connected to embedded software.

The capacity of the processor to do specific tasks is dependent on embedded C programming. In our daily lives, we use a range of technical devices such as a telephone, a washing machine, and a digital camera. A microcontroller programmed in embedded C controls all of these devices.

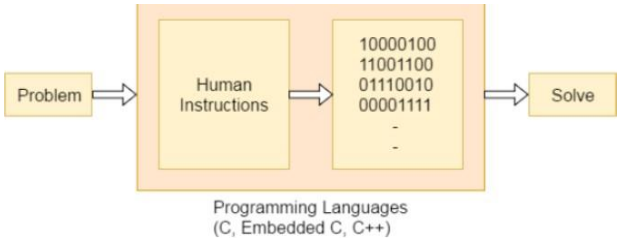

Figure 9: Block diagram of Embedded C development

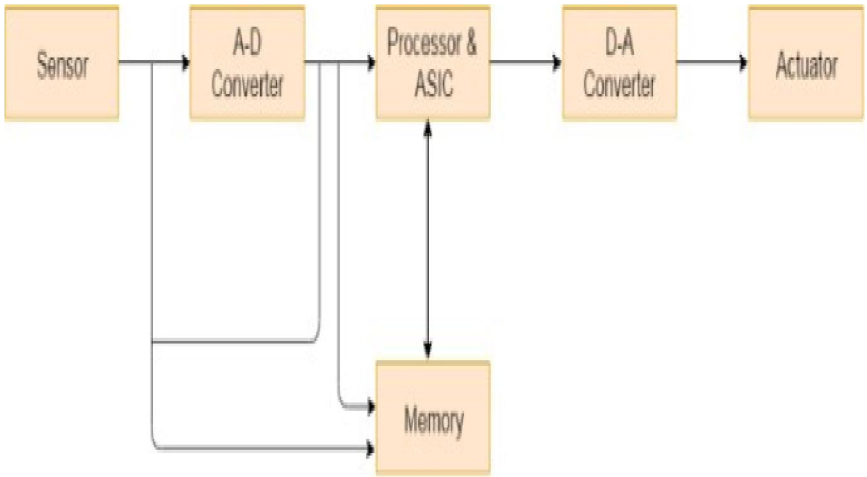

Figure 10: Working of Embedded C

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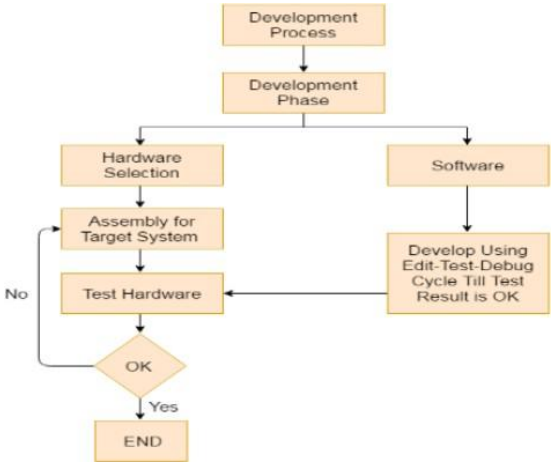

Figure 11: Working block diagram of Embedded C

B. UART Protocol

The UART (Universal Asynchronous Receiver/Transmitter) is a hardware communication mechanism that uses asynchronous serial communication at a variable speed. Because there is no clock signal to synchronise the output bits from the transmitting device as they travel to the receiving end, they are asynchronous. The two signals on each UART device are named:

Transceiver (Tx)

Receiver (Rx) (Rx)

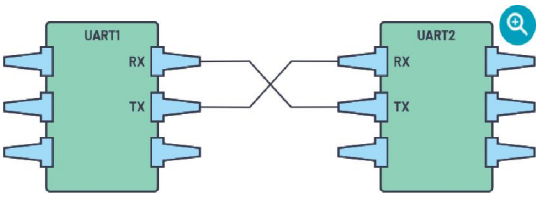

Figure 12: Two UARTs directly communicate with each other

The transmitter and receiver lines on each device's transmitter and receiver lines have the primary function of transmitting and receiving serial data for serial communication. The transmitting UART is connected to a controlling data bus, which transfers data in parallel. Through the transmission line, the data will now be serially delivered, bit by bit, to the receiving UART (wire). As a result, for the receiving device, the serial data will be transformed to parallel.

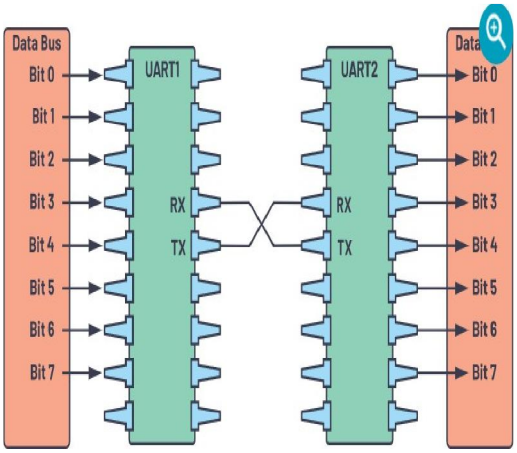

Figure 13: UART with data bus.

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UART lines are used to deliver and receive data as a communication method. It's worth mentioning that a UART device has distinct transmit and receive pins for data transmission and reception. For UART and most serial connections, the baud rate on both the sending and receiving devices must be the same. The baud rate is the speed at which data is transmitted through a communication channel. The chosen baud rate controls the maximum number of bits per second that can be exchanged over a serial connection.

Steps of UART Protocol

First, the sending UART simultaneously receives data from the data bus.

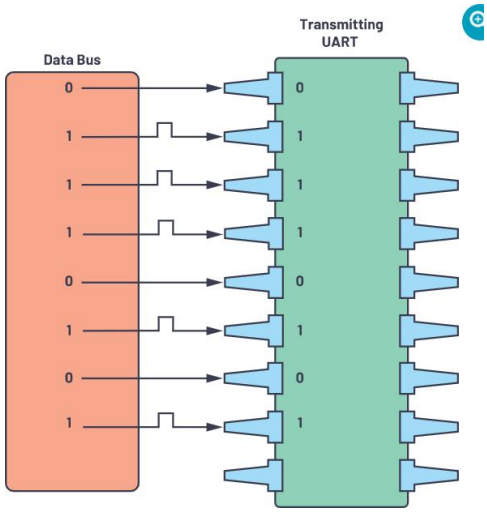

Figure 14: Data bus to the transmitting UART.

Second, the transmitting UART inserts the start bit, parity bit, and stop bit of the data frame (s).

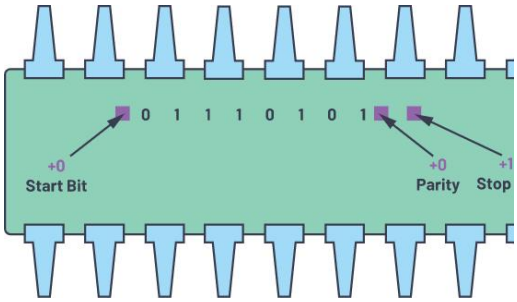

Figure 15: UART data frame at the Tx side

Third, starting with the start bit and concluding with the stop bit, the entire packet is serially sent from the transmitting UART to the receiving UART. The receiving UART samples the data line at the set baud rate.

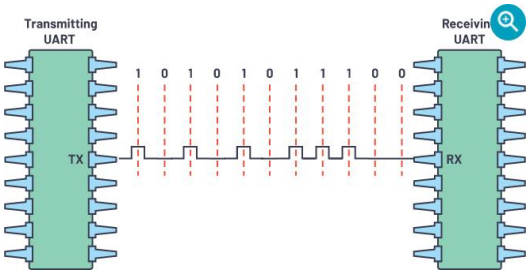

Fig 16. UART transmission

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Fourth, the start, parity, and stop bits of the data frame are discarded by the receiving UART.

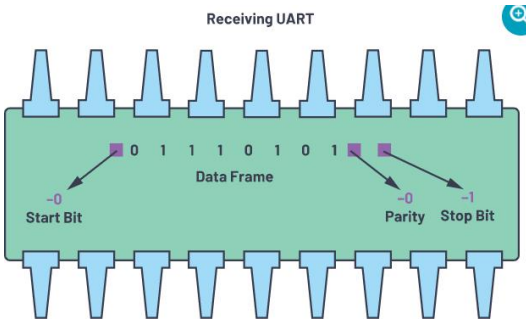

Figure 17: The UART data frame at the Rx side

Finally, the receiving UART converts serial data to parallel and sends it to the data bus.

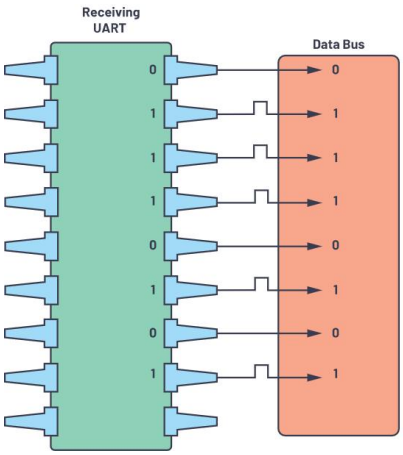

Figure 18: Receiving UART to data bus.

III. Conclusion

Inflammation of vascular endothelial cells is linked to varicose veins in the lower legs. This paper uses vascular endothelial cells as the study object to create a deep convolutional neural network for varicose veins in the lower extremities in order to improve classification and identification accuracy. The network first analyses the data layer using the Google-inception Net model as the first convolutional layer, then extracts multi-scale picture features using multiple convolutional layers to increase the network's feature extraction capabilities. Simultaneously, rather of employing the ReLU activation function, the MFM activation function is employed to create a competitive mechanism that can extract more compact features and minimise network layer parameters, hence improving network performance. When compared to existing networks, this one can boost feature extraction capabilities, has quick operating speed, few network settings, and is suitable for small embedded devices. Model of deep convolutional neural networks Even if the experimental results in this study were very satisfactory, there are still a few issues when it is only employed in an experimental environment in clinical practise. The network will then be improved and applied to clinical practise.

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