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Raspberry Pi and Image Processing Based Electronic Voting Machine (EVM)

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Abstract— Electronic voting machine has already been developed and widely used in many developed countries. But most of them use Radio Frequency ID. In developing countries RFID for each person does not exist. And using RFID is still a costly solution. Some of the developing countries use image processing technique to detect citizens. But only image processing is not enough.

Keeping these problems in mind this paper a raspberry pi will be used as host. The Raspberry Pi is a credit card sized single computer or SoC uses ARM1176JZF-S core. SoC, or System on a Chip, is a method of placing all necessary electronics for running a computer on a single chip. It needs an Operating system to start up. SD/MMC card will acts as a bootable hard disk. A camera will be used to take picture of citizen's national ID card and identify that this user is valid voter for that region. If the citizen is valid and also didn't vote then the person will be allowed to submit his/her vote. Each voting machine is locked by finger print access module. As the user is identified his/her finger print will be sent to a specific machine for voting. Each voting machine is networked with the central raspberry pi voting identification system.

Keywords - Raspberry pi, electronic voting machine, pattern recognition, communication, sensor.

I. INTRODUCTION

E-Voting has been a very controversial topic ever since The Presidential Elections in the U.S. in 2000. Many Security flaws were found. The Standards for the implementation of E-Voting systems were shown to be too weak and many (Scientific) Experts expressed their negative opinions on E-Voting. Nevertheless, efforts are still made to introduce e-voting in Countries that use traditional paper ballots. E-Voting is an Election Method in which the Votes are Cast or Collected electronically. A Computer System whose main element is a Software Component that maps the voting procedure electronically is called an E-Voting System. A *Direct Recording Electronic* (Dre) Machine is a special case of such a system as it implements all steps in the voting process, from registration and ballot casting to counting. There are two different forms of voting: Distance and Presence Voting. In Presence Voting, a voter can cast his or her vote in a polling station under the supervision of the election's administration. Examples for presence voting are conventional elections in polling stations or voting with E-Voting Machines. In Distance Voting, the voter acts without the supervision of the electoral commission and casts his or her vote from a place.

II. BLOCK DIAGRAM

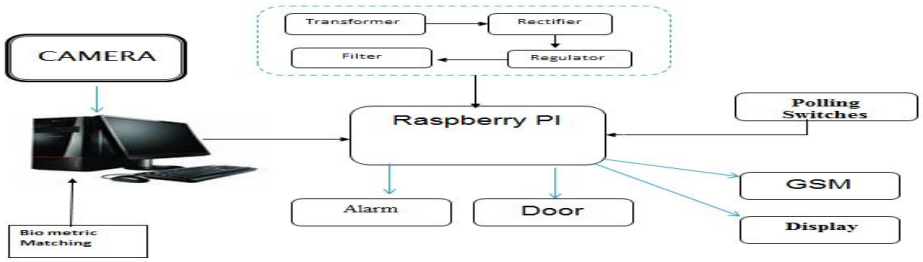

Figure.1. Raspberry Pi based electronic voting machine

The finger vein and face recognition gets MATLAB which is compared with existing Images. If the image is matched, the computer sends the command the person is valid to the micro controller and displayed. If anyone try to poll their vote beyond the time limit is the GSM modem send the message alert to authorized person. This processor is implemented on Raspberry Pi Board. So this board is connected with monitor, camera, and SD card. Those all components are connected by USB adaptors. Once the base station confirms the voter as valid member it transmits finger print of the voter in a specific voting machine. Finger print sensor takes the finger print of the voter. When the finger print matches the voting machine gets unlocked and ready to accept the vote otherwise it

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will remain locked.

III. HARDWARE COMPONENTS

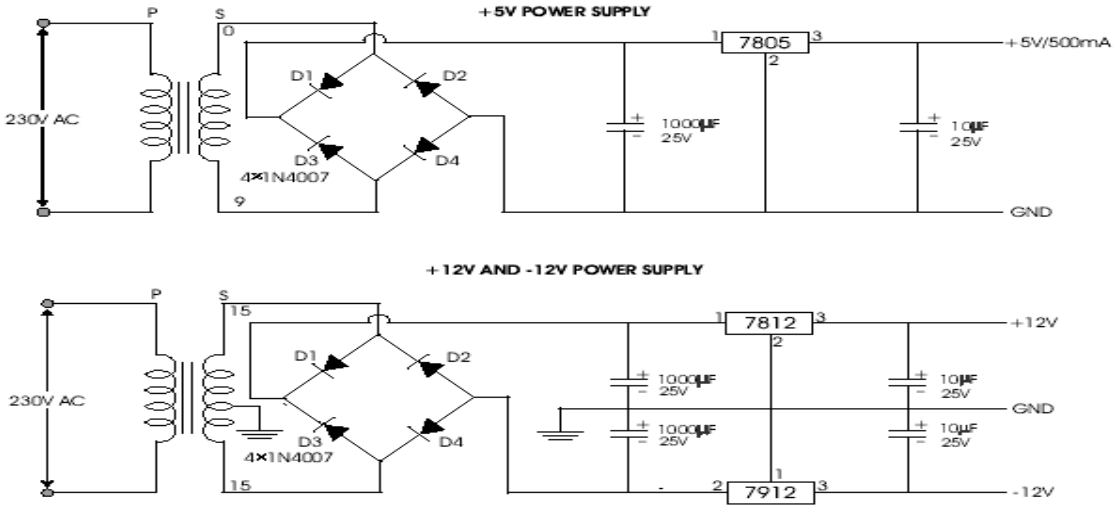

Figure.2. Power Supply

The AC voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired DC output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes.

A. Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

B. Bridge Rectifier

When four diodes are connected as shown in figure.2, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4. The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow. The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. This path is indicated by the solid arrows. Waveforms can be observed across D1 and D3. One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1 and back to point A. This path is indicated by the broken arrows. Waveforms can be observed across D2 and D4.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

C. IC Voltage Regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts. A fixed three-terminal voltage

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regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground. The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

IV. RASPBERRY PI

The Raspberry Pi is a series of credit card–sized single-board computers developed in England, United Kingdom by the Raspberry Pi Foundation with the intent to promote the teaching of basic computer science in schools and developing countries. The original Raspberry Pi and Raspberry Pi 2 are manufactured in several board configurations through licensed manufacturing agreements with Newark element14 (Premier Farnell), RS Components and Egoman.

The hardware is the same across all manufacturers. In February 2016, the Raspberry Pi Foundation announced that the device has sold eight million devices, making it the bestselling UK personal computer, ahead of the Amstrad PCW. All Raspberry Pis include the same Video Core IV graphics processing unit (GPU), and either a single-core ARMv6-compatible CPU or a newerARMv7-compatible quad-core one (in Pi 2); and 1 GB of RAM (in Pi 2), 512 MB (in Pi 1 models B and B+),or 256 MB (in models A and A+, and in the older model B). They have a Secure Digital (SDHC) slot (models A and B) or a Micro SDHC one (models A+, B+, and Pi 2) for boot media and persistent storage In 2014, the Raspberry Pi Foundation launched the *Compute Module*, for use as a part of embedded systems for the same compute power as the original Pi.[In early February 2015, the next-generation Raspberry Pi, Raspberry Pi 2, was released. That new computer board is initially available only in one configuration (model B) and has a quad-core ARM Cortex-A7 CPU and 1 GB of RAM with remaining specifications being similar to those of the prior generation model B+.

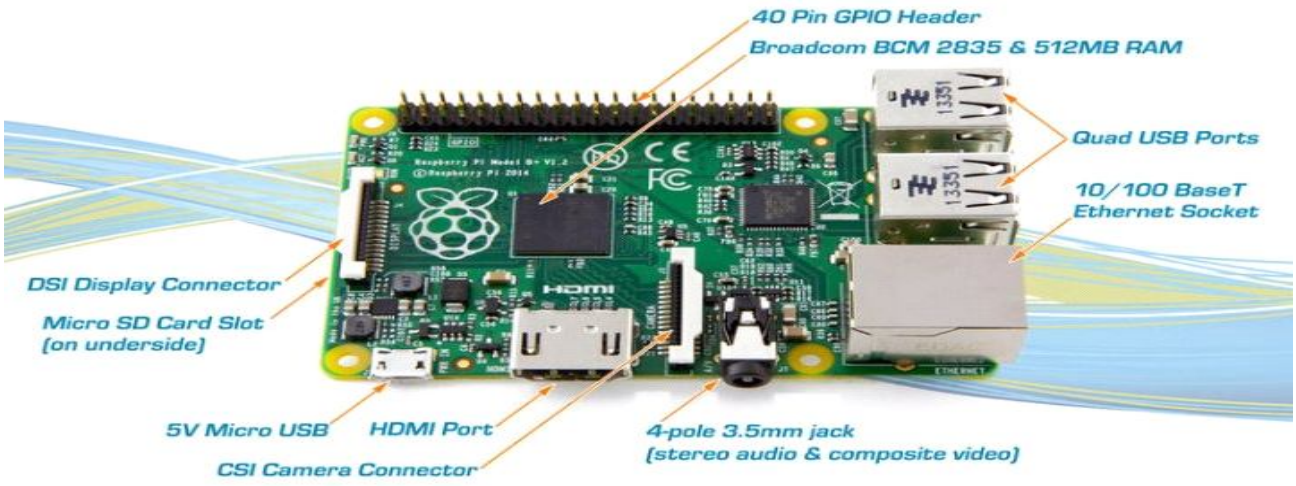

Figure.3. Raspberry pi

The Raspberry Pi 2 retains the same US$35 price of the model B, with the US$20 model A+ remaining on sale. In November 2015, the Foundation launched the Raspberry Pi Zero, a smaller product priced at US$5. Raspberry Pi 3 was released on 29 February 2016. The Foundation provides Debian and Arch Linux ARM distributions for download, and promotes Python as the main programming language, with support for BBC BASIC (via the RISC OS image or the Brandy Basic clone for Linux),[C,C++, Java, Perl, Ruby, Squeak Smalltalk and more also available. Raspberry Pi 3 has a new BCM2837 SoC retaining compatibility with the GPU, CPU and connectors of its predecessors BCM2835 (Pi 1) and BCM2836 (Pi 2), so all those projects and tutorials for Pi 1 and Pi 2 hardware should continue to work. The 900 MHz 32-bit quad-core ARM Cortex-A7 CPU complex has been replaced by a 1.2 GHz 64-bit quad-core ARM Cortex-A53. Combining a 33% increase in clock speed with various architectural enhancements, this provides a 50–60% increase in performance in 32-bit mode versus Raspberry Pi 2, or roughly a factor of ten over the original Pi 1Hardware

A. Processor

The system on a chip (SoC) used in the first generation Raspberry Pi is somewhat equivalent to the chip used in older smartphones(such as iPhone, 3G, 3GS). The Raspberry Pi is based on the Broadcom BCM2835 SoC,[2] which includes an 700 MHzARM1176JZF-S processor, Video Core IV graphics processing unit (GPU), and RAM. It has a Level 1 cache of

16 KB and a Level 2 cache of 128 KB. The Level 2 cache is used primarily by the GPU. The SoC is stacked underneath the RAM chip, so only its edge is visible. The Raspberry Pi 2 uses a Broadcom BCM2836 SoC with a 900 MHz 32-bit quad-core ARM Cortex-A7 processor, with 256 KB shared L2 cache

B. Real-Time Clock

The Raspberry Pi does not come with a real-time clock, which means it cannot keep track of the time of day while it is not powered on. As alternatives, a program running on the Pi can get the time from a network time server or user input at boot time. A real-time clock (such as the DS1307, which is fully binary coded) with battery backup may be added (often via the I²C interface).

V. TOOLS

A. Types of software tools

1) PYTHON: Python is a widely used high-level, general-purpose, interpreted, dynamic programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or Java. The language provides constructs intended to enable clear programs on both a small and large scale. Python supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library. Python interpreters are available for installation on many operating systems, allowing Python code execution on a wide variety of systems. Using third-party tools, such as Py2exe or Py installer, Python code can be packaged into stand-alone executable programs for some of the most popular operating systems, allowing the distribution of Python-based software for use on those environments without requiring the installation of a Python interpreter.

2) MATLAB: Environment and fourth-generation programming language. A proprietary programming language developed by MathWorks, MATLAB allows matrix manipulations MATLAB (matrix laboratory) is a multi-paradigm numerical computing, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java, Fortran and Python. Although MATLAB is intended primarily for numerical computing, an optional toolbox uses the MuPAD symbolic engine, allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems.

3) RASPBIAN OS

Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi.

The initial build of over 35,000 Raspbian packages, optimized for best performance on the Raspberry Pi, was completed in June of 2012. However, Raspbian is still under active development with an emphasis on improving the stability and performance of as many Debian packages as possible.

Note: Raspbian is not affiliated with the Raspberry Pi Foundation. Raspbian was created by a small, dedicated team of developers that are fans of the Raspberry Pi hardware, the educational goals of the Raspberry Pi Foundation and, of course, the Debian Project

B. Hardware Tools

1) Raspberry pi
2) LCD
3) RS232 Serial Communication
4) Keypad
5) Finger Print sensor
6) Camera
7) RF Transmitter and receciver

a) RS 232: When we look at the connector pin out of the RS232 port, we see two pins which are certainly used for flow control. These two pins are RTS, request to send and CTS, clear to send. With DTE/DCE communication (i.e. a computer

communicating with a modem device) RTS is an output on the DTE and input on the DCE**.** CTS are the answering signal coming from the DCE**.**

Before sending a character, the DTE asks permission by setting its RTS output. No information will be sent until the DCE grants permission by using the CTS line.

b) *MAX 232:* MAX-232 is primary used for people building electronics with an RS-232 interface. Serial RS-232 communication works with voltages (-15V ... -3V for high) and +3V ... +15V for low) which are not compatible with normal computer logic voltages. To receive serial data from an RS-232 interface the voltage has to be reduced, and the low and high voltage level inverted. In the other direction (sending data from some logic over RS-232) the low logic voltage has to be "bumped up", and a negative voltage has to be generated, too.

i. *RS232 Communication:* In telecommunications, RS-232 is a standard for serial binary data interconnection between a DTE (Data terminal equipment) and a DCE (Data Circuit-terminating Equipment). It is commonly used in computer serial ports.

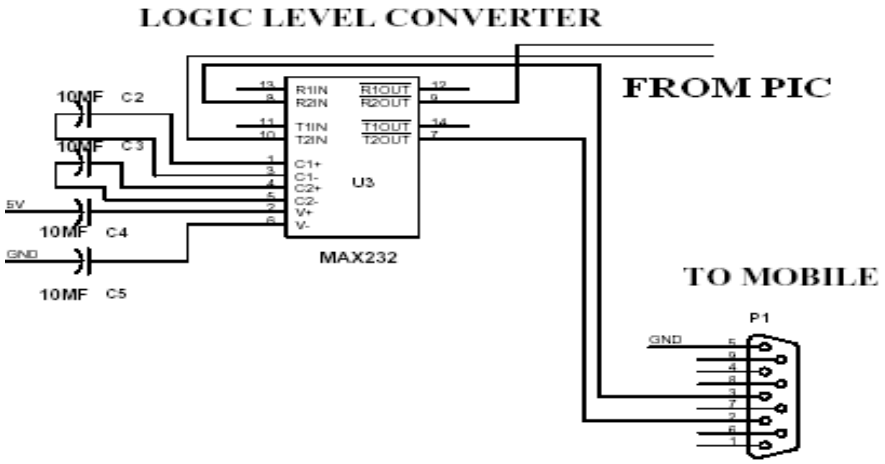

Figure.4. Circuit Diagram of Serial Communication

ii. *Finger print sensor:* Finger Print Recognition

Fingerprint recognition refers to the automated method of verifying a match between two human fingerprints.

Fingerprints are one of many forms of biometrics used to identify an individual and verify their identity. The analysis of fingerprints for matching purposes generally requires the comparison of several features of the print pattern.

These include patterns, which are aggregate characteristics of ridges, and minutia points, which are unique features found within the patterns.

PATTERNS: The three basic patterns of fingerprint ridges are the arch, loop, and whorl.

Arch Pattern:

An arch is a pattern where the ridges enter from one side of the finger, rise in the center forming an arc, and then exit the other side of the finger.

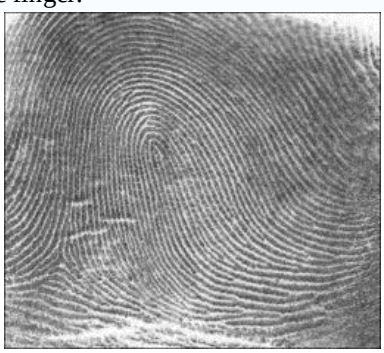

Figure.5. Arch pattern

Figure.6. Loop pattern

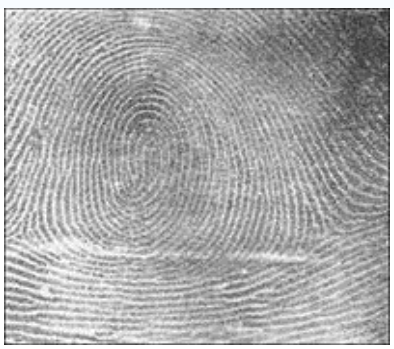

Figure.7. Whorl pattern

Loop Pattern:

The loop is a pattern where the ridges enter from one side of a finger, form a curve, and tend to exit from the same side they enter.

Whorl Pattern:

In the whorl pattern, ridges form circularly around a central point on the finger.

MINUTIA FEATURES:

The major Minutia features of fingerprint ridges are: ridge ending, bifurcation, and short ridge (or dot).

Right Ending: The ridge ending is the point at which a ridge terminates.

Bifurcation: Bifurcations are points at which a single ridge splits into two ridges.

Short Ridge: Short ridges (or dots) are ridges which are significantly shorter than the average ridge length on the fingerprint.

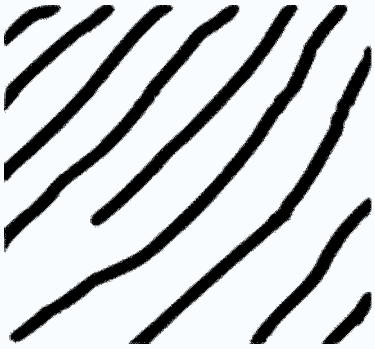

Figure.8. Right ending

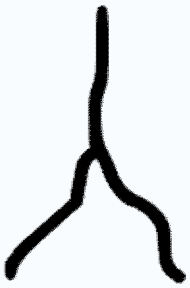

Figure.9. Bifurcation

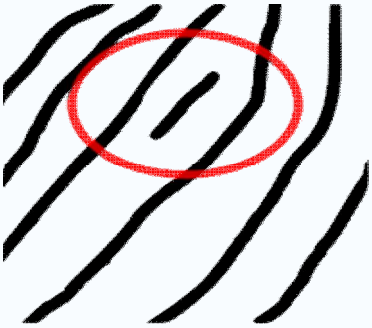

Figure.10. Short ridge

FINGER INTERNAL OPERATION

Futronic FS80 USB2.0 Fingerprint Scanner uses an advanced CMOS sensor technology and precise optical system to deliver high quality fingerprint image. The finger is illuminated by 4 infra-red LED's during scanning and the light intensity is automatically adjusted according to scanning fingerprint's characteristics (wet, dry, blurred, etc) to optimize the quality of the captured finger print image. The WHQL approved Futronic FS80 Fingerprint Scanner uses advanced CMOS sensor technology and state of the art optical systems to capture high quality fingerprint images that can be uploaded on PC in 100ms.

LCD MODULE (2X16 CHARACTER)

Dot matrix LCD modules is used for display the parameters and fault condition.16 characters 2 lines display is used. It has controller which interface data's and LCD panel. Liquid crystal displays (LCD's) have materials, which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal. An LCD consists of two glass panels, with the liquid crystal material sandwiched in between them. The inner surface of the glass plates are coated with transparent electrodes which define the character, symbols or patterns to be displayed polymeric layers are present in between the electrodes and the liquid crystal molecules to maintain a defined orientation angle.

Figure.11. LCD Diagram

The LCD's are lightweight with only a few milli meters thickness. Since the LCD's consume less power, they are compatible with

low power electronic circuits, and can be powered for long durations.

VI. CONCLUSION

The paper includes the initial works done for the development of a system that aims to dictate a much larger scale of the voting frontier. Thus the machine still has many limitations that need to be overcome to allow it to reach the level it is aimed for. Starting with the devices integrated in the machine, for large scale production and use the devices need to be upgraded to better or alternate versions. The fingerprint sensor that was previously used had a low threshold for the output confidence level and overall low efficiency, and so the Adafruit fingerprint sensor is an improvement on those levels. However, the fingerprint sensor used has a limit on the memory storage as the fingerprints obtained are stored in its internal memory. A total of 256 fingerprints may be stored in the device, but for large scale operations the device will be an obstacle. Another obstacle arising from the fingerprint is the possible chance of a voter enrolling with more than one fingerprint data. If by some circumstance the voter is able to provide more than one fingerprint, then the voter would be able to enter the system more than once. Interfacing between Arduino and Raspberry Pi using USB causes the connection to be safer to an external jammer.

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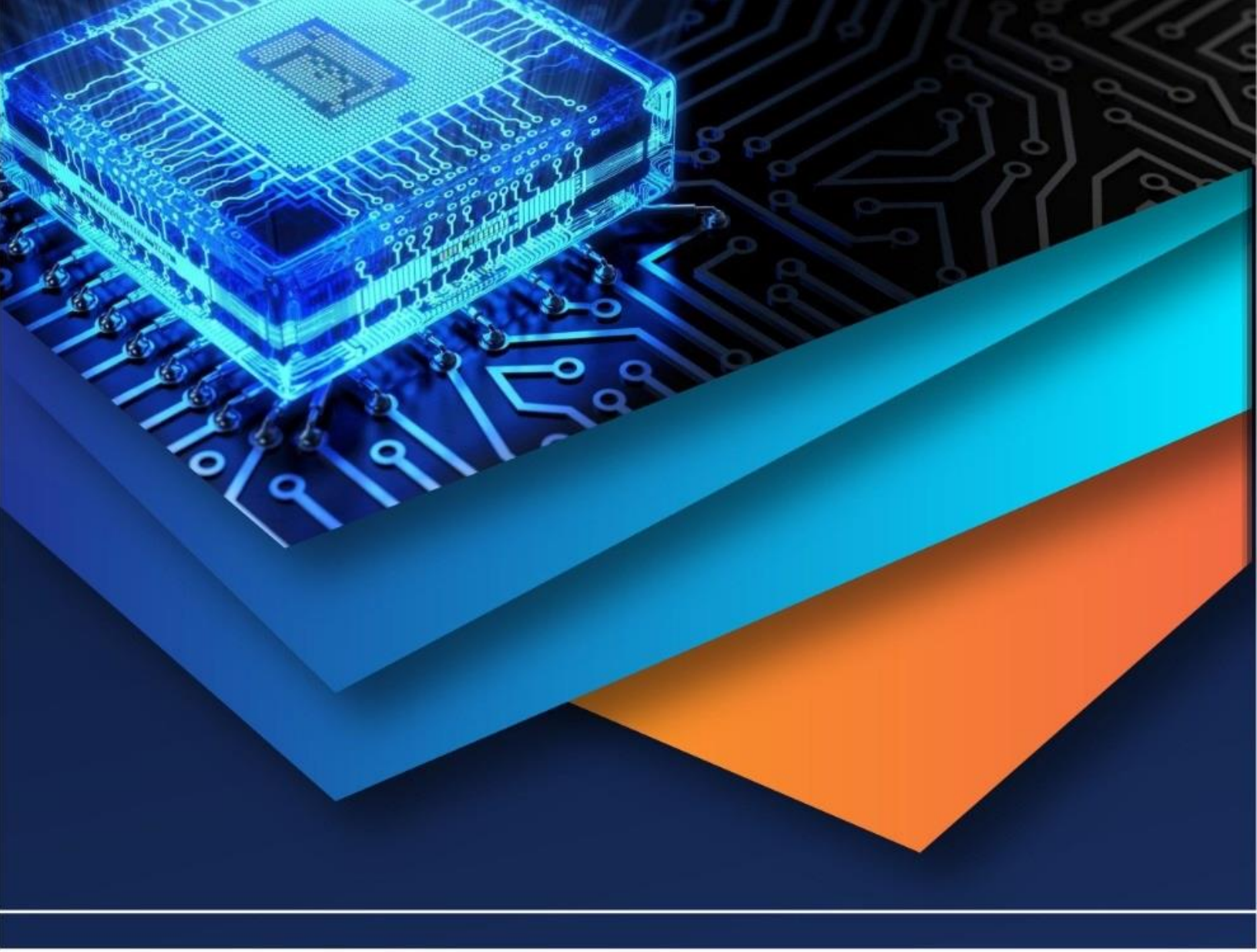
He is currently working as an Assistant Professor in Valliammai Engineering College, Chennai, South India. His area of interest includes Process Control, Industrial Instrumentation, Transducers and Sensors. Completed his Master of Engineering in the field of Control and Instrumentation. He did his Bachelor of Engineering in the field of Electronics and Instrumentation Engineering. He has published many journals under the field of Instrumentation Engineering.

He is currently working as an Assistant Professor in Valliammai Engineering College, Chennai. His area of interest includes VLSI Design, Wireless Communication, and Embedded Systems. He is working in the area of Implementation of FPGA in wireless Applications in his Research work.Completed his Master of Engineering in the field of VLSI Design in 2008 . He did his Bachelor of Engineering in the field of Electronics and Instrumentation Engineering. He has vast experience in teaching Engineering and Technology.



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