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Speed Synchronization of Multiple Motors in the Textile Industry

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***Abstract:** In the many industries, synchronization of motor is very important. The difference in motor or desynchronization in motor leads to wastage of power and wastage of resources. The main aim of this project is to run the multiple motors simultaneously using wireless technology. Example, in textile industry, motor worked simultaneously on conveyor belt to draw the cloth. It is important that multiple motors run at the same speed. So, to avoid damaging the cloth, to solve this problem, this project is implemented. Speed synchronization of multiple motors in textile industry using Arduino UNO, BLDC motor, potentiometer, LCD, IR sensor, RF module of 433 MHz, and ESC,LCD.It has a transmitter side motor. The speed is measured in RPM using IR sensor and receiver receives the wirelessly using RF receiver module. Receiver side data and speed adjust according to transmitter motor speed. This helps to run all motors at the same speed.*

I. INTRODUCTION

In the textile industry, many machines like spinning and weaving use more than one motor. If all motors do not run at the same speed, it can create problems such as thread breakage and wastage of material. So, synchronization of motor speed is very important for smooth working and better production. To solve this issue, I decided to make a project called “Speed Synchronization of Multiple Motors in the Textile Industry.” In this project, I am using Arduino UNO, BLDC motor, IR sensor, RF module, ESC, potentiometer, LCD, and RF receiver. The main idea is to measure the speed of one motor using the IR sensor and then send that speed data wirelessly to another motor through the RF module. The receiving motor automatically adjusts its speed and matches with the master motor. In this way, all motors can run at the same speed without manual control.

II. LITERATURE REVIEW

[1] Ankur Shukla, Ankit Kumar, Anil Kumar Rajak,Vivek Kumar Singh, Santhosh S, Ankur Shukla et. “Speed Synchronization of Multiple BLDC Motors In Textile &Paper Mills Using Micro Controller” Int. Journal of Engineering Research and Applications www.ijera.com,ISSN : 2248-9622, Vol. 5, Issue 5, (Part -3) May 2015, pp.52-55. Multiple motor setup has vast application in industries. The application can be in textile mills, paper mills and robotics. these all application the synchronization is must between the motors to perform certain task. Speed synchronization is very essential in these all operation to avoid damage to the product. The synchronization is done by using microcontroller chip which controls the master slave whose speed is followed by the other motors which all have to be synchronized.

[2] M. Karthigeyan, K. Nama Shivayam, B. Sunil Shaajan, S.Sivaswami, “Speed Synchronization of Multiple Motors in Industries” International Journal of Advanced Research in Computer and Communication Engineering, ISO 3297:2007 Certified, Vol. 7,Issue 4, April 2018.In various industries speed synchronisation of the motor plays a major role. Mainly, in textile industries the differential speed error leads to much consumption of power. The aim of this project is synchronization of multiple motors using wireless technology. In textile mills wheremultiple motors work simultaneously on a conveyor belt to draw clothes, it is essential that all the motors there should run at same speed, so that balanced tension is achieved to avoid clothesgetting damaged. In this work motors are wirelessly synchronized to reduce the differential speed error among multiple motors. One motor act as transmitter and the rest as receivers. Brush Less Direct Current Motors (BLDC) used operate on the basis of Pulse Width Modulation (PWM) control. The pulse width output from the microcontroller would be automatically adjusted to maintain the DC power to the motor such that the entered speed percentage matches the running Rotation Per Minute. The above operation is carried out by using electronic speed controller for driving the BLDC motor duly interfaced from the

[3] MR. Vijay Patil, Vaishnavichikane, SanketShinde, Gauri Salave, Vijay Shinde, “Speed Synchronization of Multiple Motors in Industries” International Journal of Scientific Research in Engineering and Management (IJSREM) Volume: 06 Issue: 06 | June - 2022 Impact Factor: 7.185 ISSN: 2582-3930.In various industries speed synchronization of the motor plays most important role.

Mainly, in textile industries, paper industries the differential speed error leads to much consumption power. In industries many processes required speed synchronization of more than one motors involved in the process. Speed control of motor is very important specially in the fields including industrial application, etc. Speed synchronization is very essential in these …

[4] Adapa V V D Saikumar, M.A.S.S PrabhakarRao, KadiyamNikeshSai, "Wireless Speed Synchronization of Motors in Industry" International Journal of Engineering Research & Science (IJOER) ISSN: [2395-6992] [Vol-2, Issue-9, September- 2016]In textile industry many processes require speed synchronization of more than one motors involved in the process. Rolling of cloth should be synchronized with the speed of weaving spindle to avoid damage and motor speed synchronization is vital in conveyor belt driven by multiple motors. Abrupt load variations may cause hunting or oscillatory behavior in d. c. machines. This behavior can be detrimental to the process. The digitally controlled d. c. machines can have much aggravated phenomenon owing to poor sampling period selection. Traditionally processes are synchronized through mechanical transmission system consisting of a line shaft gears, pullers etc. This project is synchronization of multiple motors using wireless technology.This project uses radio frequency to synchronize motor speeds. One motor acts as transmitter and all the rest as receivers. Thus, if a particular speed is set in the transmitter then all other motors speed would be matched to the same speed of the main motor.The mode of communication is radio frequency. BLDC motors used operate on the basis of PWM control. Each motor has a closed loop feedback mechanism providing RPM reference by a shaft mounted IR sensor arrangement whose output is fed to the controller in the circuit. A display unit displays the full speed and one can enter the desired percentage with help of a keypad to obtain the required speed for all the motors. Manpower and time is also saved in this system.

III. SYSTEM DESIGN

A. Material used:

1) BLDC motor: BLDC motor does not have carbon blocks due to that there is less friction and more efficiency. It has more efficiency compared to other DC motors. They are compatible with digital drive system and low noise operation reduce the maintenance. Receives PWM signal from the Arduino UNO control motor speed and direction.input is lithium battery 11.1v

2) ESC: Electronic Speed Controller.Helps to control the speed and direction ofBLDCmotor.ESC is an electronic speed controller. It is a three-phase. It converts DC to AC due to its three phases. It takes pulses or a signal from the audio UNO and drives the BLDC motor according to the pulses. It has three wires The wires are connected to the BLDC and thick wires are connected to the phase A, B, C.

3) RF Transmitter 433MHZ: Sends data wirelessly to the RF Receiver motor side On the transmitter side, the potentiometer is used to set the motor speed IR sensor measures the RPM of the motor

4) IR sensor: used to Measures rotation and calculates the RPM of the motor And continuously monitor the how fast motor is running

5) LCD: Displays angle and RPM of the motor.

6) Potentiometer: in the potentiometer manually set the speed of the motor Usually the Analog input those goes to the Arduino that convert into digital value

7) Arduino UNO: The Arduino UNO takes data from the potentiometer and those Data read and map and convert into the digital data or value send those to esc To control the motors .

8) RF Receiver. Receives data from the RF Transmitter and sets the same speed as the transmitter motor.

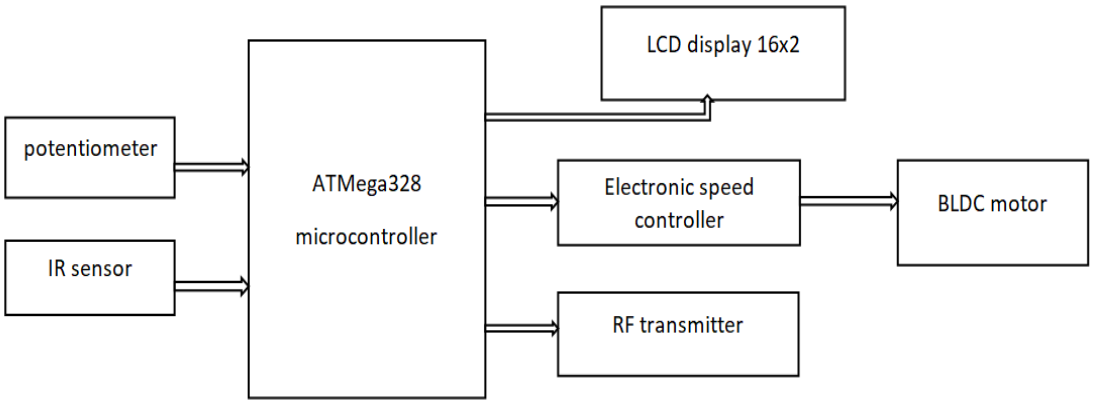

Fig 1.1 : Block diagram of transmitter of speed synchronisation of multiple motors in textile industry

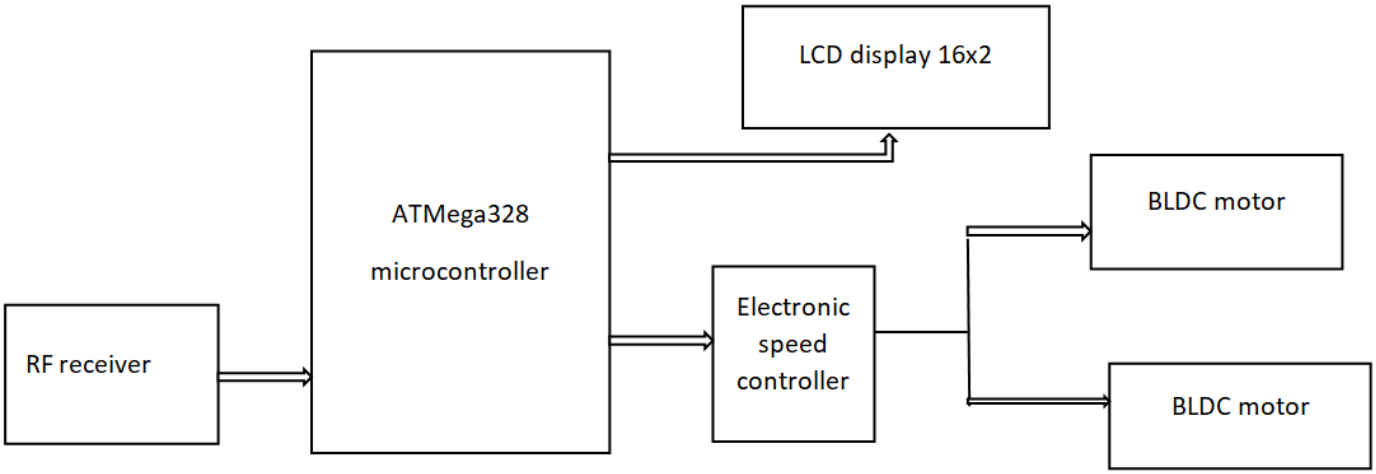

Fig 1.2 : Block diagram of receiver of speed synchronisation of multiple motors in textile industry

IV. METHODOLOGY

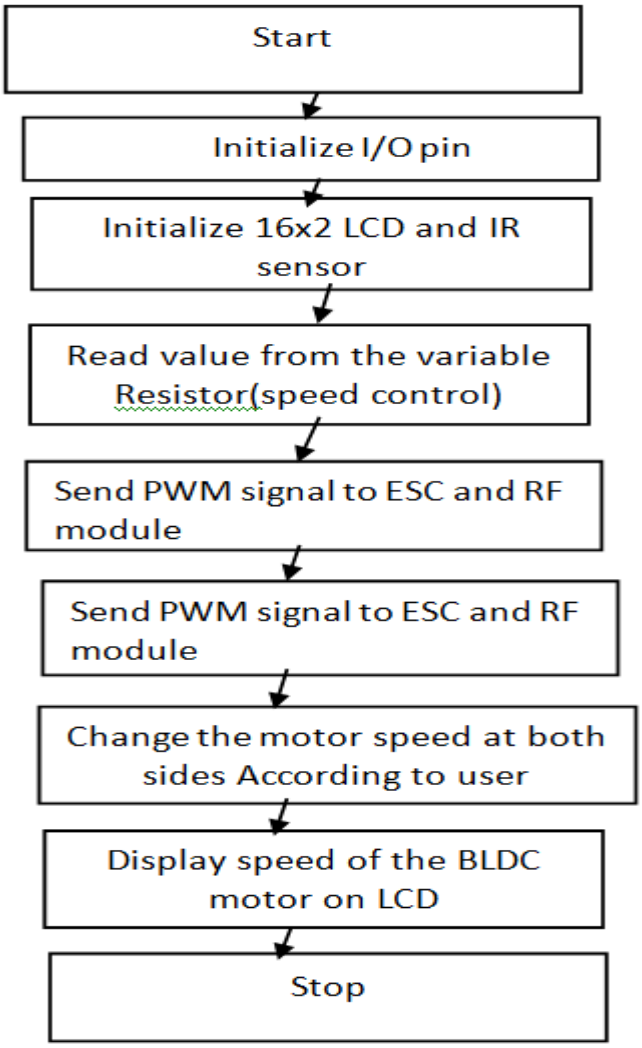

Fig.2.1Flow chart of speed synchronization of multiple motors in textile industry

V. EXPERIMENTAL ANALYSIS

Experimental analysis refers to the detailed examination of results to evaluate system performance. In this project, it involves testing all motors simultaneously, continuously measuring their RPM using IR sensors, and comparing their speeds at each instant. The analysis includes calculating errors, such as absolute error and synchronization error, and identifying the causes of these errors, including communication delay, ESC response, calibration issues, load variations, and sensor inaccuracies. Additionally, it involves determining the difference between the fastest and slowest motors at any given time to assess the degree of synchronization.

VI. RESULT AND DISCUSSION

Parameters	Master side	Slave side
Speed range	500-300 rpm	480-2950 rpm
Synchronization error	--	5-10%
Wireless communication Successfully	RF TX 433MHZ	data RX
IR sensor accuracy	95 %	92%
Response time	1-2 second	2-3 second
Motor driver/esc performance	good	good
Distance covered correctly	15-30 meters	data received
Overall synchronization result	---	successfully

Discussion:

1) Experimental results clearly show that the wireless synchronization system using a 433 MHz module is effective for textile industry applications.

2) During testing, all motors maintained their speed even when the load was high on one motor.

3) The IR sensor successfully measured the RPM and transmitted real-time data to the receiver. The slave motor automatically adjusts its speed using the AC motor driver.

4) The range of the transmitter is 15 to 20 meters, or approximately 20 to 30 meters. This distance is suitable to provide stable signal quality, minimize data loss, and ensure accurate speed synchronization.

TRANSMITTER SIDE OUTPUT :

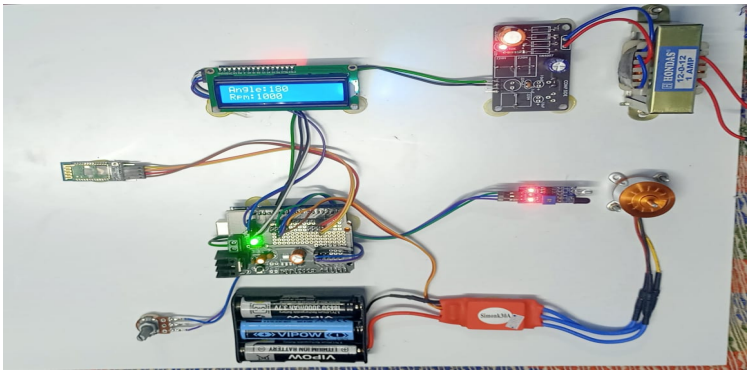

Fig 2.2 TX side

RECEIVER SIDE OUTPUT :

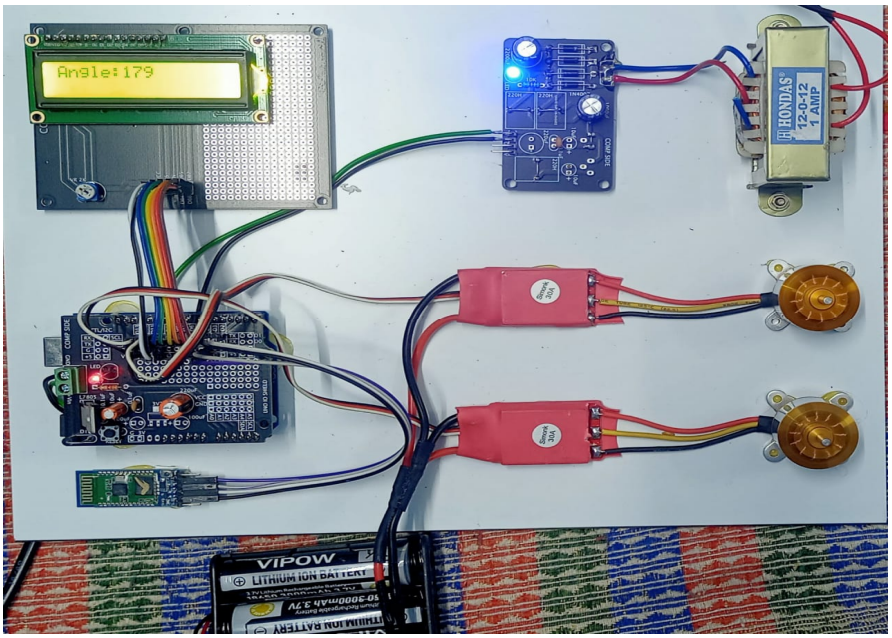

Fig 2.3 RX side

VII. CONCLUSION

The speed synchronization of multiple motors in textile industry is very important for smooth and reliable of machines in industry. By using wireless communication systems as Arduino ,rf module ,IR sensor, esc ,potentiometer, LCD,BLDC motor, power supply etc. All motors can run at the same speed without manual adjustment through air wirelessly with the help of rf transmitter. This help in the fabric quality, reduce wastage of resources, reduce energy consumption enhance automation and increase productivity

REFERENCES

[1] Ankur Shukla, Ankit Kumar, Anil Kumar Rajak, Vivek Kumar Singh, Santhosh S, AnkurShukla et al. “Speed Synchronization of Multiple BLDC motors In Textile &Paper Mills Using Micro Controller” Int. Journal of Engineering Research and Applications www.ijera.com, ISSN : 2248-9622, Vol. 5, Issue 5, (Part -3) May 2015, pp.52-55.

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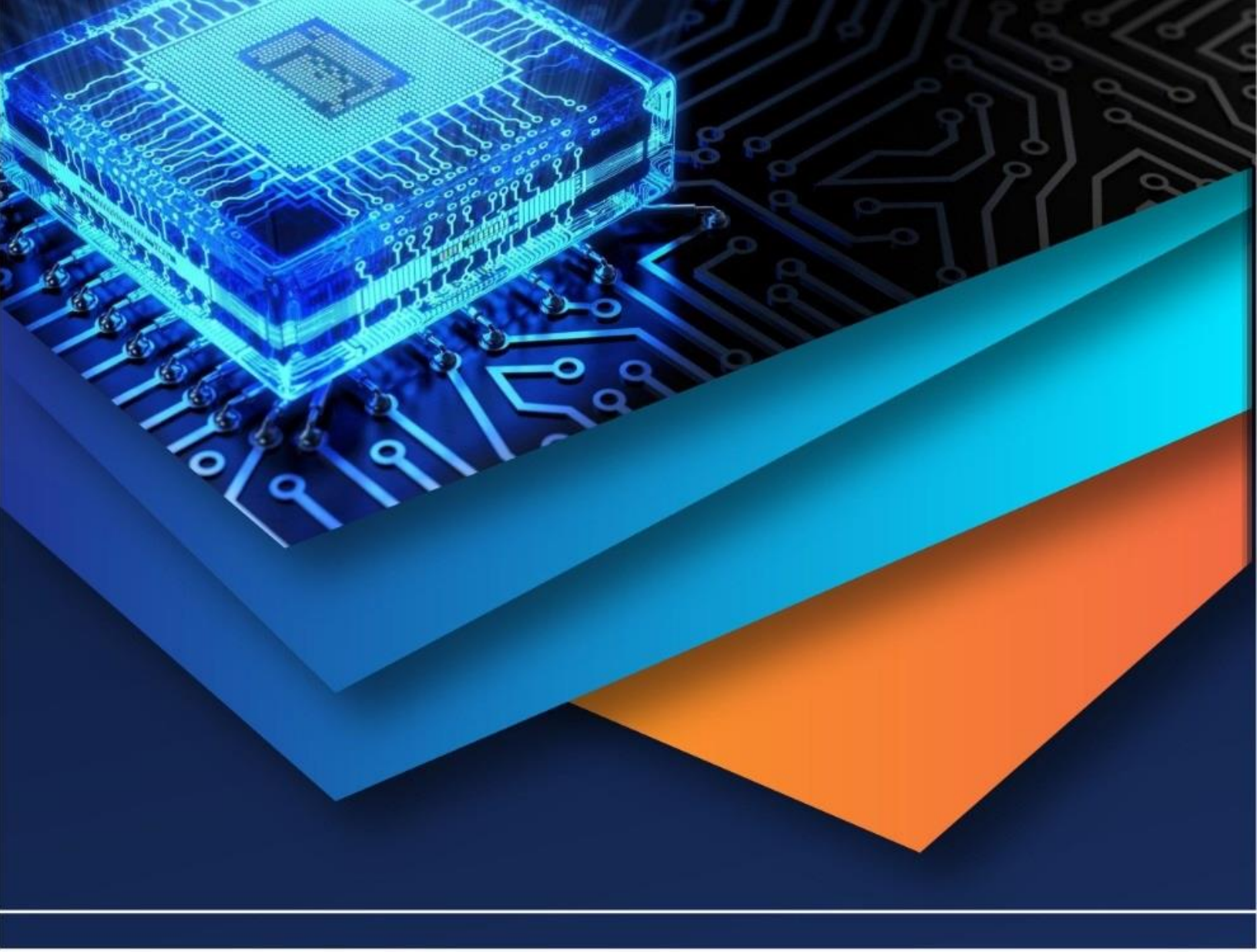
[5] Adapa V D Sai Kumar, M.A.S.S PrabhakarRao, KadiyamNikeshSai, “Wireless Speed Synchronization of Motors in Industry” International Journal of Engineering Research & Science (IJOER) ISSN: [2395-6992] [Vol-2, Issue-9, September- 2016.



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