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Implementation Real Time Data to Control Feed Rate and CSS of Cone Crusher Plant

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ABSTRACT: As per observation and analysis of various crushing industries. The crushing plants divides into different categories. So, we can classify into small size, medium size and large size. In these industries crushing process operation perform as per capacity and demand. Mostly large size stone crushing plant install with automatic operation. In these plants the feed material sizes, reduction ratios and crusher operation parameters introduces plant production efficiency. A Cone crushers machine is a versatile machines and this one uses as per requirements of site as well as demand. The crushing plant major objective is to reduces large size stones into small sizes. As per observation standard 4:1 reduction ratio. Basically, need proper test of feed particles properties of shape and design to increase performance of plant. The final product size is dependant on the setting of the crusher, so for comparison of particle shape and the size range analysis related to crusher setting (CSS). A Cone crushers machine is a versatile machines and this one uses as per requirements of site as well as demand. The crushing plant major objective is to reduces large size stones into small sizes. Actually, when we have need in small zone that we can operate in manual but for large scale production use new advance technology to improve machine protection, wear compensation and increasing production ratio. As per analysis of cone crusher process plant the energy consumption in this plant play an important role. As per the system requirements programmable logic controller(PLC), human machine interface(HMI), energy meter, temperature sensor, pressure sensor, VFD and its peripheral devices use to access data of plant then stored for future reference as a feedback data acquisition. The first basic algorithms develop for feed rate control through VFD using cavity level through sensor and on-off signal when overflow or underflow. The feed control system work like PID controller and logic execute in PLC system. The algorithm automatically calculate for changes in the feed material and decreases the need for adjustment of the CSS(close side setting). The second algorithms develop to maintain CSS(close side setting) in cone crusher. The CSS is an important factor of cone crusher, basically various types of test perform and result simulate in graph showing CSS with load and without load. All these type test simulation result implementation for plant process. A cone crusher plant overall performance increase with increase in production due to upgrade technology and energy consumption decreases. All analysis and observation completed on site with actual data feeding.

KEYWORDS: Feed rate, PLC, HMI, CSS, cone crusher, crushing, Implementation, Protocols.

I. INTRODUCTION

In the crushing industries as per this system need to adopt different-level automatic process control system and increase the efficiency of crushing and screening. In present time control system add multiple process of control action on single platform to perform better result as per production. As per the modern concepts of "Internet of Things" and "Industry 4.0". The increasing in industrial devices, machines and units are combine with advance automation systems to develop with the use of advance industrial controllers. All these devices we can access worldwide through wireless communication system[1]. A control system perform operation with use of Human- Machine Interface (HMI) implementing in software and programmable logic controller use for program part and interconnect with field devices. In this paper introduces for cone crusher plant feed rate control and CSS adjustment as per process running. In this paper basic analysis points include with CSS setting and adjust automatic when need as per the process demand[7, 9].

Problems and Solutions : As per my deep analysis and observation some points have problems in existing system:

- Protection of the users and crusher plant with safety point.
- Cone crusher and process control in ideal condition.

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- Feed rate control and CSS adjustment.

For above problem solution below point execute during installation & testing.

- Adopt advanced technology to protect for failure and unwanted shutdown.
- Process parameter interlock with control systemand stored in system log.
- All work done on site with different test & found accurate result.

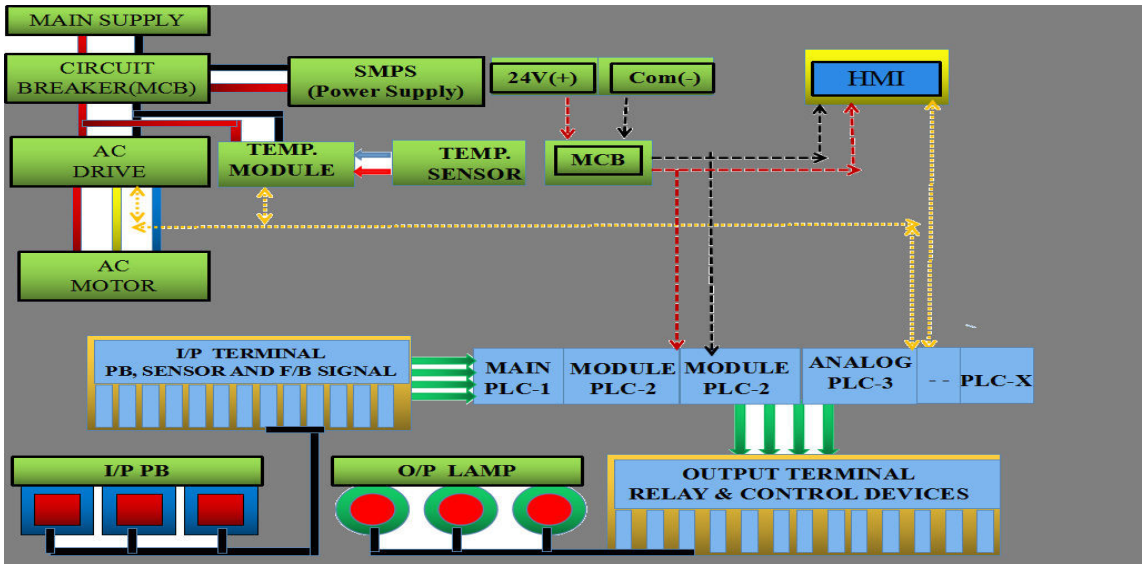

Fig 1 : Cone Crusher layout diagram of internal control system design.

In figure 1 define PLC, HMI, drive, sensor, output field devices use for plant automation and result oriented working as per process requirements. For the complete automation maximum delta make hardware and software uses and process complete with proper efficient production as well as data acquisition[6, 12].

II. SYSTEM OVERVIEW

In this systemonly discuss about major components as per title of paper.

1. **Cone Crusher and CSS :** This cone crusher system automatic adjust CSS setting as per set by operator. In this system major points to focus like cavity level sensor, linear scale, running CSS, limit value and motor run status. All analog sensor uses 4-20mA range with high accuracy for plant operation. As per system running CSS and other values getting from these sensors then compensate output result from PLC logic. All values monitor and showing on HMI[2, 3, 5].

2. **Hydraulic system with sensors :** The hydraulic system of this plant is also known as root of the plant when system work in fully automatic mode. In hydraulic system some points to be consider more important for control system like lubrication pump status, hydraulic motor status, cooling fan, temperature and pressure sensors. The lubrication pump system use to circulate lubrication in whole system. When temperature value exceed the set value that time cooling fan automatic operated. All temperature and pressure transmitter uses for protection and operation perform. When system in running condition that time pressure sensor play an important role otherwise system will be damages. If pressure too high while crushing process running that time auto compensate CSS value and reduce pressure and if pressure more than maximum set value that time plant shutdown immediately with alarm generate[9].

3. Feed rate control through feeder : The feeder status vary plant to plant and this feeder control in manual mode as well as in auto mode. In this observation feeder work in auto mode and control speed through variable frequency drive(VFD). The plant in running status that time feeder run when crusher motor in run mode, cavity level in range, metal detector in healthy condition. The speed of feeder control as per the cavity level as well as process flow requirements. When CSS function out of range that time feeder stop immediately to increase protection of plant[4, 10].

4. Automatic control system : A plant process flow layout diagram showing in figure 2. The control system also known as a heart of process unit. In this system programmable logic controller(PLC) use to create all analog and digital logic as per process demand. So system work as per logic and control all devices with better protection without human

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interference. As per the logic all sensor provide input signal to PLC the PLC generate logical output to control field devices like motor, valve and other peripheral devices. In this system Human machine interface(HMI) use for plant monitoring as well as data acquisition[11]. All process data store in HMI and useful for analysis purpose. As per control system some other electrical and electronics devices also uses in system like temperature module, energy meter, electrical switch gear etc. The main objective of control system is to protect system from any type of problem or unwanted condition. The industrial parameter like pressure, temperature, level control through analog transmitter(4-20)mA of pressure and temperature. The PLC logic develop in ISP Soft and HMI design completed through DOP Soft. As per the system requirement remote accessing, that time we can access complete system worldwide through E-remote and E-server software[5, 12].

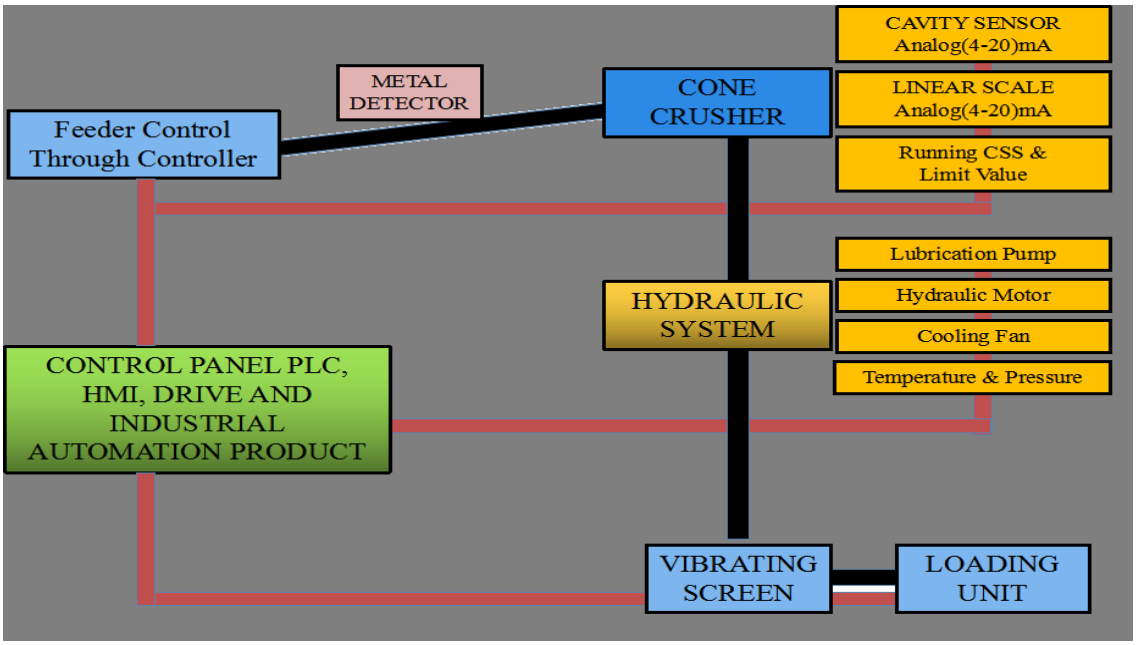

Fig 2 : Cone Crusher Plant process flow layout diagram.

5. **Test and Result Analysis :** As per the system overview and analysis test perform without load and with load. On site different type of test perform and result analysis. All these test important for plant operation and performance analysis. These test result implement in plant operation through control logic with all safety points interlocks[6].

5.1 **Test without load :** In this first test the positioning of the piston with no feeding of stone into the cone crusher chamber. This test show the crusher control is working as ideal and the low load on the main shaft to minimize the risk of new develop hydraulic system. This system show the right dimensions of valves to get proper flow rate.

Result : As per first test the system arrange to set the CSS between the mantles to 5.0 mm, then adjust it to 15.0 mm and then again back to 5.0 mm. This test perform without any load(particles) in the crusher so the pressure is low in the hydraulic system. As seen in the figure 3, when the main shaft lifting towards 5.0 mm CSS that time reference CSS follow by measure CSS. At the time of low pressure during the lowering of the main shaft towards 15.0 mm CSS, that time measure CSS not follow the CSS reference, in this test orifice fully open. I the low pressure condition valve not working as per their characteristics, due to this when crusher is unloaded that time flow is low. Of course, due to this reason calibration process too much slow.

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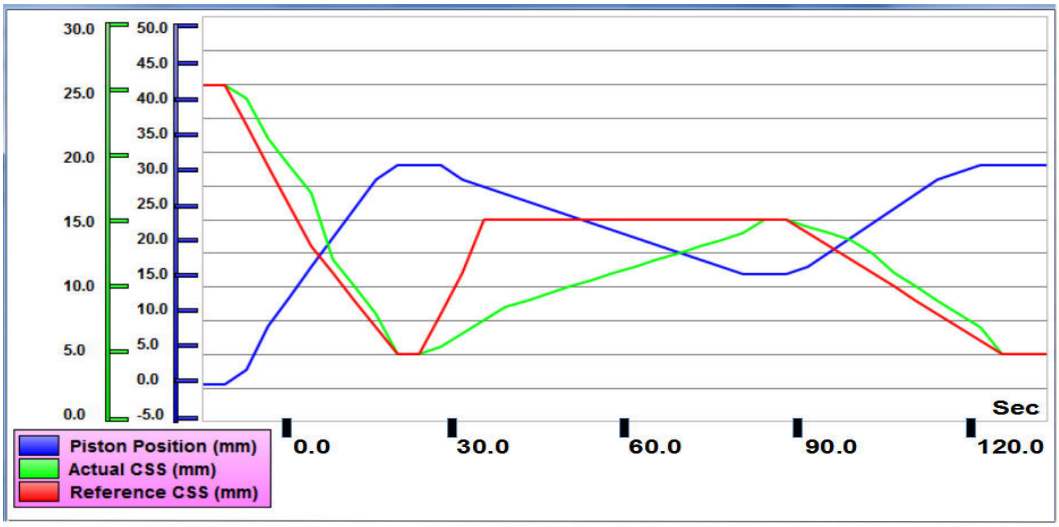

Fig 3 : Test-1 showing CSS adjustment without load.

5.2 Test with load and adjust CSS : In test with load and fix CSS, the basic variation in running CSS as well as multiple time down valve operate. So in adjust CSS with load problem solve of fix CSS with load. In this test the hydraulics systemadjust the CSS when feeding load. This is showing that the systemis following the ramp in the position control loop when crushing process is running. As per this test CSS automatic set as per the systemrequirements.

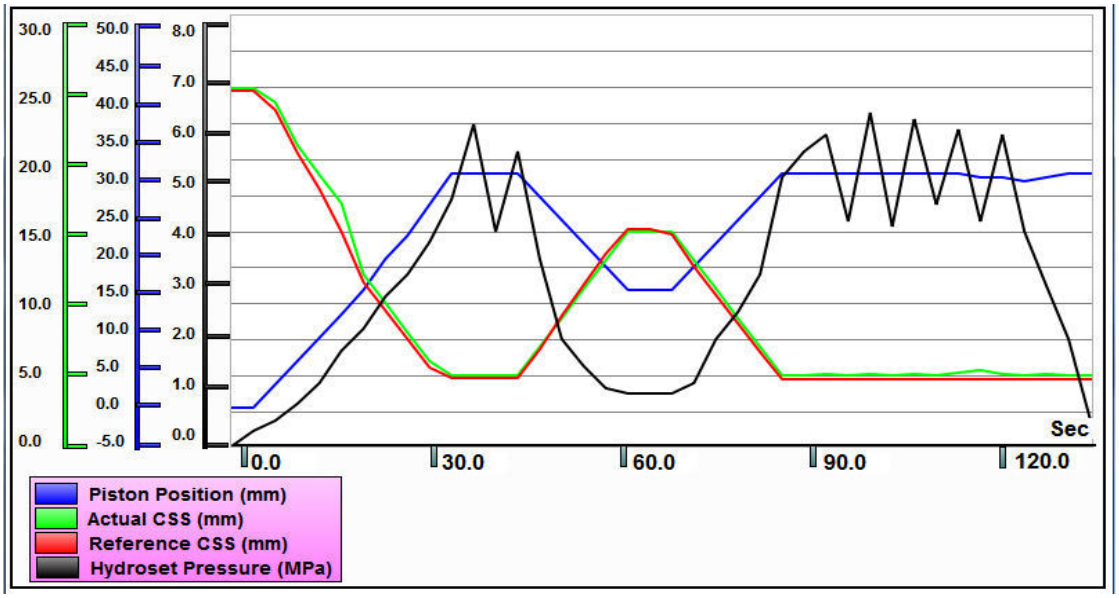

Fig 4 : Test-2 showing adjust the CSS with load.

Result : In this system the errors in the control loop correct and the crusher feeding with stones. In figure 4 showing the CSS plot without fluctuation in actual measure value , and the down valve doesn 't open as regularly. The CSS is set to 5.0 mm then feeding and the pressure auto increase to 4.5 MPa when crushing start. Now when the crusher chamber on full load with lowering of main shaft follow the reference signal because of higher pressure and better flow through th e valves. When reach 15.0 mm CSS, the CSS is again set back to 5.0 mm and now seen how system work when crusher in running condition. The system follow the reference signal when crushing. As per observation and analysis of the result proper selection of machine with test result.

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III. SCOPE OF ANALYSIS

As per this paper the scope of analysis directly effect on crushing industries to protect from unplanned shutdown and protection from all system parameters. This analysis is useful for all industrialist as well as institution level to understand and execute in their plant. In this control CSS and feed rate of cone crusher plant is an important factor. In this system use advance control system, also introduces "Internet of Things(IOT's)" and "Industry 4.0". The major thing is that due to advance technique increase ratio of production and decrease maintenance cost. The CSS maintain as per process setting parameters and executes different level of logic. In future new development of these type of system easily design with respect to real time values. Finally, I would like to say that always new technology improve the systemperformance and result.

IV. CONCLUSION

All data collect from field devices to access in PLC system and these data provide the output result to control CSS as well as feeding control rate. This system economical and user friendly. In this project report define basic components of crushing industries and real time parameters with data acquisition system. As per the my observation all data are important for present and future analysis. As per this system new control technology use to improve performance, reliability and decrease maintenance cost.
In final conclusion, I would like say that these type of systemwe can install in small scale as well as large scale industries.

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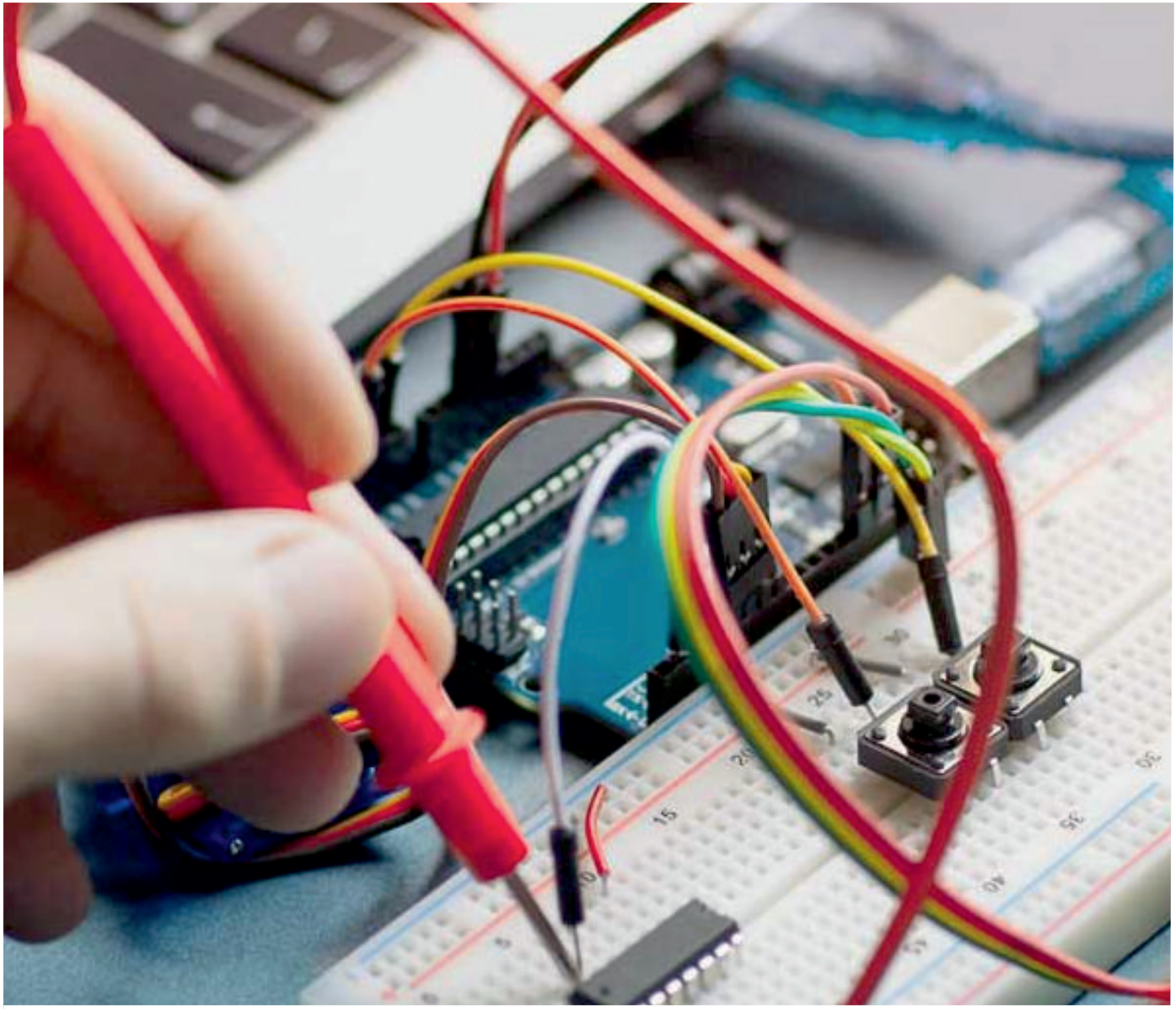

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