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Implementation of an Efficient SMD Component Counter using LASER Sensor

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Abstract: ***Bulk parts such as RC components, SMD components, packaged in reel type, are plenty of use in the SMT factory application. When the SMD reel arrives, it is not possible to count all the SMD components and verify if a dealer has given the right number of required components. If the components delivered are less than required components then it may hamper the production line, pick and place robots and consume the deadline time which can lead to damage to the company's time and money. To overcome this problem the precise counting device is required to build. Which will count the SMD component and display the number of present and missing components. Also, which will do the given task in a minimum amount of time. The compact model is required for the industrial application which will save space and transportation cost. This project mainly focuses on counting and detecting missing SMD components from the reel and the outcome of counts and missing components will be displayed to the operator. It makes a perfect tape assessment stage not withstanding its tallying capacity.***
Keywords: SMD Components, SMD Resistor, LASER sensor, Surface Mount Technology, Surface Mount Device, SMD Counter

I. INTRODUCTION

The size of emerging technologies is decreasing day by day, one such technology is SMD Components which is widely used in the Industries nowadays [2]. The various SMD Components available in market are Resistors, Capacitors, LED, Diodes, Transistors etc. Sometimes the packaging may have some missing components in between and it is hard to detect because of their small size. This might arise problem during production or there are other areas where counting of components is needed.
We have designed and implemented an automated system which can count and detect the mislaid components.
Our system is drafted only for the variety of SMD Components with available pitch size and are frequently used. Various consideration of compact and easy to use system has been considered while designing this system [5].

II. REALIZATION OF THE SYSTEM

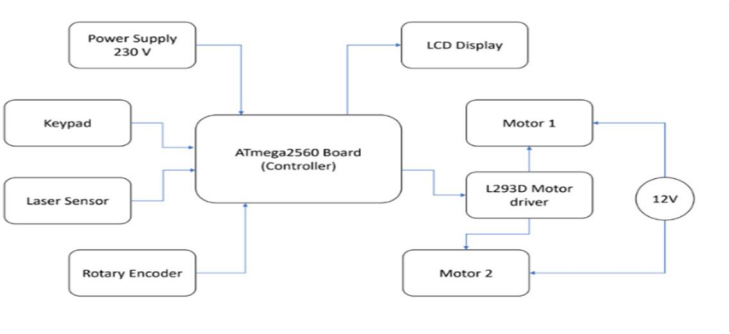

Fig. 1 Block diagram of the System

The SMD Resistor are packed in a reel and rolled onto a disc. For counting, the resistor filled reel is transferred over the other empty reel placed at the opposite end of the system. The reel is passed through the LASER sensor which detects the missing resistor.
There were many design considerations to implement this system as it should be precise with its counting. The system should also be stable enough to balance out the vibration caused by the two motors, rotating at a speed of 150-300rpm. Along with that the challenge was to keep the moving reel stable in a line of view in front of LASER sensor and keep it focused on the components [3].
As it would be frequently in use, batteries are not profitable option as a main power supply. Hence an AC/DC adaptor is our source supply for the microcontroller which is a ATmega2560 Board easily available in market. The motor driver requires separate 12V DC supply for constant working speed of motor and controlling.

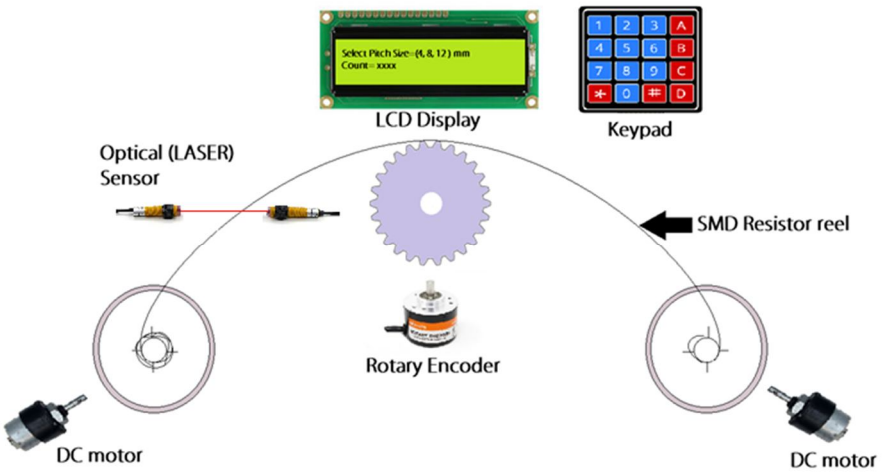

Fig. 2 System design for the Counter Machine

This system has a Human -Machine Interface to enter the size of pitch, preset the count and choose the operation mode. It can let you choose the direction of rotation as it is a bi-directional system and stop the process.
There are many types of sensors which can be used for the detection of components, but as the size of SMD Resistors decreases as per their values, we needed a sharp focused and accurate device for counting purpose. Our vision was to develop an efficient system, with minimum investment. Accordingly, we discarded the X-rays, IR sensor, Image Processing etc. options [4][6]. Lasers are trending, developing technology and are very substantial over other technologies [1]. Our goal was to keep it simple and effective, so we have used laser sensor and the easily available electronics.
Rotary Encoder is a position sensor used to determine the angular direction of the rotating shaft for the clockwise and anti-clockwise sensing of motors.

III. CONCEPT OF PITCH SIZE

Every SMD reel tape have punched holes on them for the determination of the pitch sizes. Each hole is separated from its adjacent hole with a distance of 4mm (P0). Pitch size is determined by the number of holes present along with a single component. According to EIA-481 standard, many pitch sizes available are 2mm, 4mm, 8mm, 12mm, 16mm, 20mm, …, 56mm.
Pitch sizes are nothing but simply distance between two adjacent components. Example of determination of pitch size is as following:

A. If there are two components along with one punctured hole, the pitch size=(1/2)x4= 2mm.
B. If there is one component along with one punctured hole, the pitch size=1x4= 4mm.
C. If there is one component along with two punctured holes, the pitch size=2x4= 8mm.
D. If there is one component along with three punctured holes, the pitch size=3x4= 12mm.
E. If there is one component along with four punctured holes, the pitch size=4x4= 16mm.

Likewise, the other pitch sizes are determined.

IV. SYSTEM DESIGNING

The system is programmed using open-source Arduino IDE Software, then interfaced with ATmega2560 Board. It is available for variety of operating systems.
A separate Motor driver is used to drive the DC motors, the reels will be placed on the shaft of the motors. There are various ICs and modules present for DC motor.
The Incremental type Rotary encoder monitors and controls the mechanical parts placed for the support of the system. A toothed disc structure (gear like) is placed over the shaft of the encoder for stability and direction control.

The logic can be explained through flowchart in Fig. 3.

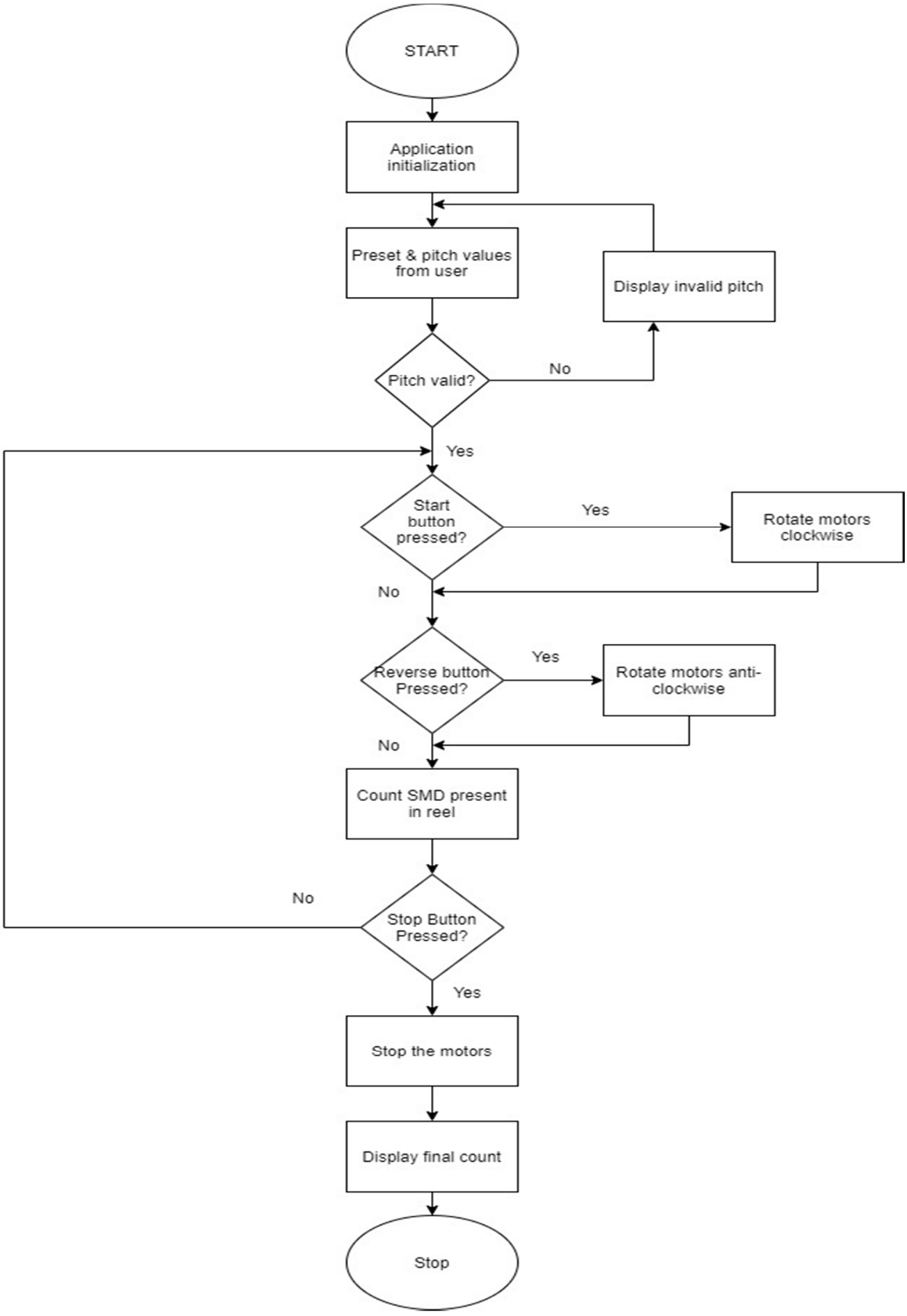

Fig. 3 A flowchart of system

V. TESTING RESULTS

1) *Display after switching ON the system.*

Fig. 4 Welcome window

2) *Enter manually the pitch size of the SMD Resistor.*

Fig. 5 Instruction window

3) *Display value of pitch size in mm.*

Fig. 6 Display of pitch size

4) *Select the direction of operation or choose other options.*

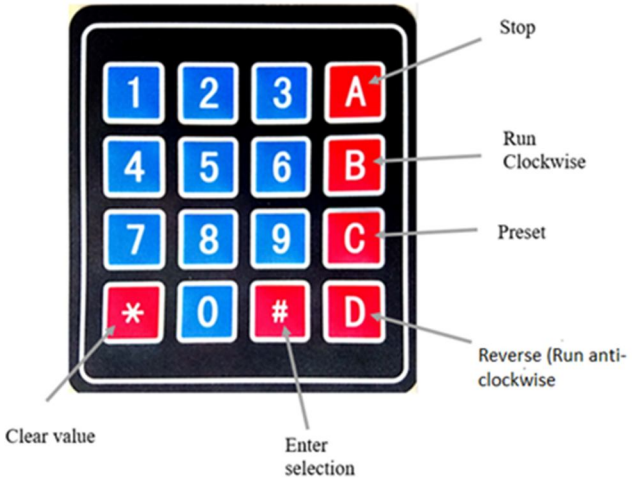

Fig. 7 Key Manual of Keypad

5) *The screen would display the values before starting the functioning.*

Fig. 8 Summary before Start

6) *Press STOP and the final reading would be displayed on the screen. If there are missing components then the system would subtract from the count and indicate on the screen.*

Fig. 9 Final count display

VI. CONCLUSIONS

SMD Component Counter is a device which counts the presence of the SMD components present on the reel, also detects the absence, if any. This device is specifically designed for SMD components with specific pitch sizes, it is highly reliable way to count the components. We have used modern technologies to design this system to get exact results.

A. It uses regular 3 phase supply, hence no battery issues and durable.
B. Freedom to choose the pitch size, it covers the whole range of available SMD component sizes.
C. It minimizes the rate of interruption in work flow when used in Pick and Place machines.
D. Separate functional blocks makes it simpler to detect the problems.
E. Can be used when the reel is in motion at variable speeds, for speed counting saves time.
F. Designed used commonly used platform, if any problems arises in future an amateur engineer can easily fix it.

VII. ACKNOWLEDGMENT

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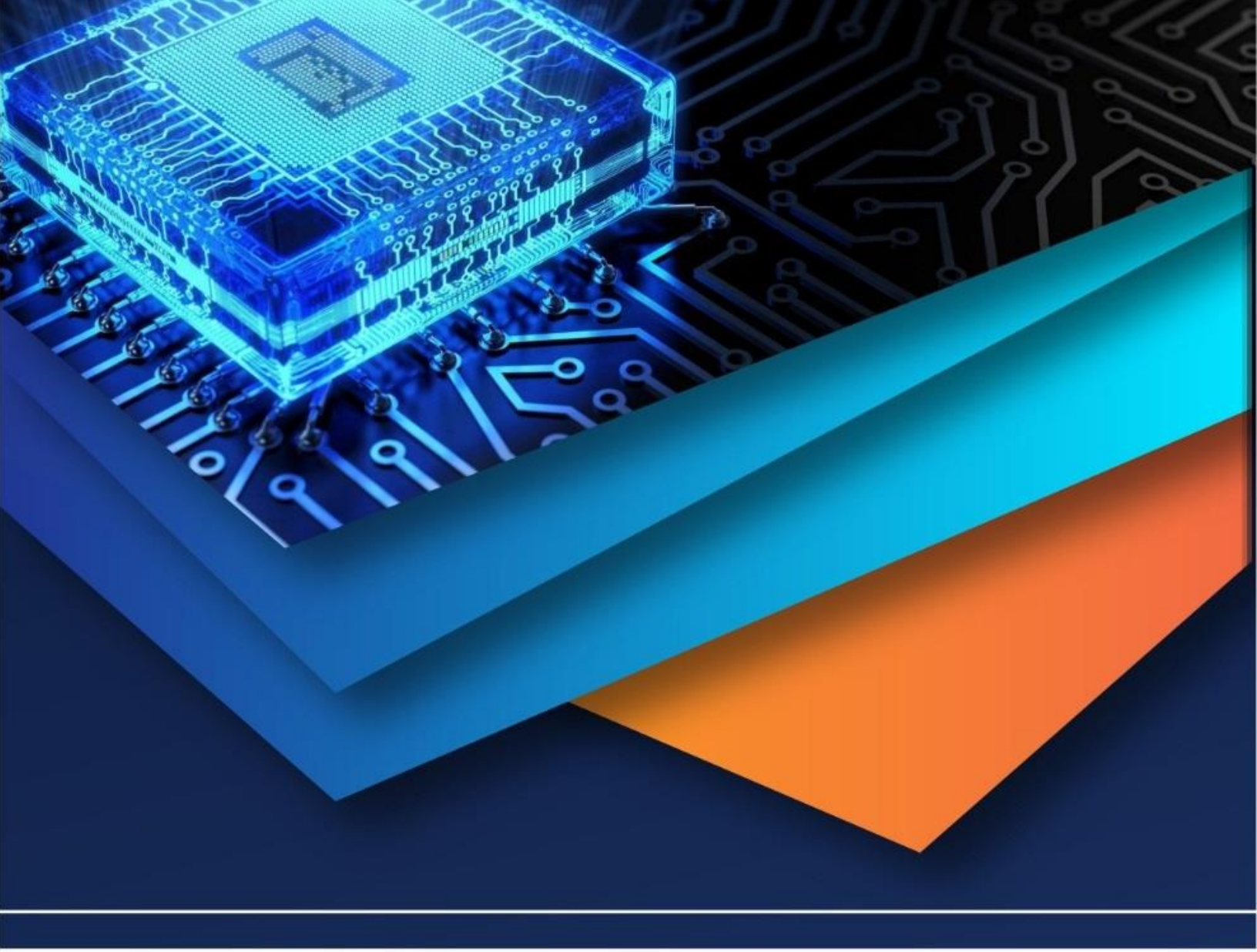

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