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Smart SMD Packer

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Abstract - *The project entitled 'SMART SMD PACKER' precisely counts the demanded number of SMD components from the roll, then carefully separates it from the strip collecting them in a packet and finally seals the packet. Currently, SMD devices are packed into rolls/strips having large number of components ranging to about 5000. This will mean that to buy these components in smaller numbers accurately, a lot of human labour has to be involved in counting, cutting, packing and sealing leading to wastage of time and resources. Acknowledging the necessity to give required number of SMD components to users efficiently in a smart way, we put forward an accurate, smart SMD components counter and cutter, which automatizes the entire process making it more user friendly. It saves both time and valuable resources. It make use of IR sensing technology for counting hence showcases an impressive degree of accuracy. Designed for common people, it is engineered with simple and user friendly modes of operations assisted with a touch interface available as an application in their smart phone. Provision to remotely manage 'smart SMD packer' regardless of their location is also provided to meet user expectations.*

Key Words: **SMD components, Counting, Cutting, Packing and sealing, IR Sensing, Touch interface**

1. INTRODUCTION

Smart SMD Packer, as the name indicates is a packing device which is smart enough to be appealing to user. It is literally a means or method by which SMD components are packed through a system of interworking components and devices. It is an efficient means to save energy, time and resources. Smart SMD Packer is a combination of integrated electronic devices working together with a central control panel to precisely count, cut and pack SMD components. It also provides provision to make demand without any ambiguity.

Increased demand for miniaturized electronics components, has led to the development of surface mount components. This provides improved electrical performance, decreased mass, and potential for a lower system cost. In addition to this, more functions can be achieved in a given volume [1]. Surface Mount Technology (SMT) is used for the production of electronic circuits in which the components are mounted or placed directly onto the surface of printed circuit boards (PCBs). It has largely replaced the through-hole technology method of fitting components with wire leads into holes in the circuit board. In addition to reducing the board area required, surface mounting eliminates the need for a via per load. Reducing the number of vias simplifies the routing of traces and also reduces the board length needed [1]. By using SMT, although the production speeds up, the risk of counting the components accurately increases due to the component miniaturization and the closely spaced assembly of components.

The growing demand of surface mount technology increases the relevance of this proposed system. The proposed system can be used for any type of SMD components for example, SMD resistors, capacitors etc. It works on simple concept of precisely counting with the help of IR sensors. Also the entire system can be controlled from anywhere by communicating with control panel set up in a convenient location.

Counting system is designed to precisely count. Counting can be achieved using Infrared technology, Laser technology or by taking length of the reel. An IR sensor consists of an IR LED and an IR Photodiode; together they are called as Photo–Coupler. Infrared receivers are also called as infrared sensors as they detect the radiation from an IR transmitter.

Packing systems are designed to carefully pack without losing or damaging any components. Here sealed packing is provided to prevent the loss of any component. The access control of the device is authorised through a user friendly android application. Once the local IP address of the system is known, it can be accessed from anywhere to place your order. Once the controller receives the order, it automatically controls all attached relay controlled motors to count and pack the components according to user demand.

2. GENERAL BLOCK DIAGRAM

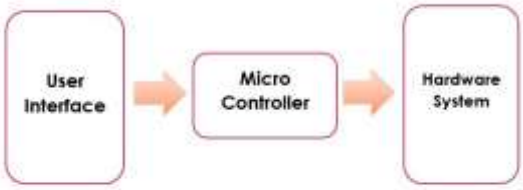

Fig-2.1: General Block Diagram

The major modules used in this project are listed as follows:

1. Mobile user interface

The mobile UI provides the user platform for communicating with microcontroller and the peripheral devices. The user can give his requirement through mobile application itself. Since the connectivity of mobile to controller is through WiFi module user can send data irrespective of their location. It allows the system to be more flexible and user friendly.

An android application has been developed as an user interface. This allows the user to input count/demand to the system. Here a analysis is made on what are the inputs and how often they are to be arranged on the input screen, how frequently the data are to be collected etc. In this project the type of SMD component selected by user and the number of that components he/she requires is the input. This is provided through a user interface.

This user interface has been designed using MIT APP INVENTOR software. This app has been designed to accept count(demand) from user and then provide it to micro controller via Node MCU. Each Node MCU has unique IP address. After determining IP address of node MCU we send the user input value to that IP address via Wi FI.

2. Controlling Assembly

- Atmega328: Atmega328 is the brain of this project. It controls the operation of the entire circuitry according to the program instructions stored in it. It receives count from the Node MCU serially and acts accordingly.

- Node MCU: Node MCU establishes wireless communication between android application and microcontroller so that input from the user reaches the device. ESP8266 -the WiFi module is embedded in Node MCU.

3. Hardware system

Hardware system includes the complete assembly of fabricated components to individually count the SMD components and separate them using cutting mechanism finally pack them in plastic covers sealed on all sides. A combination of rollers and gears are timed and used for the working of packing mechanism.

3. CIRCUIT BLOCK DIAGRAM

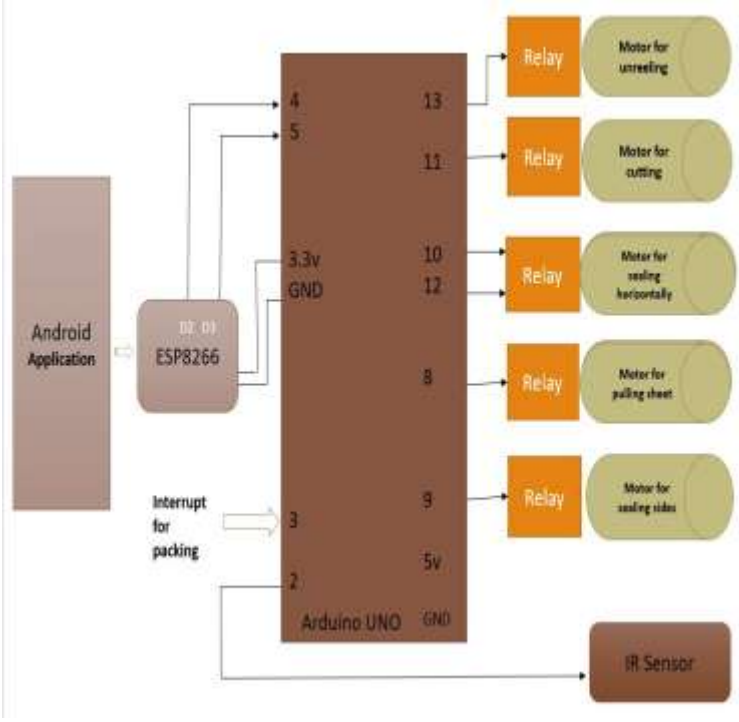

Fig-3.1: Circuit Block Diagram

In fig 3.1 Pins D2 and D3 of ESP8266 (WiFi module) are configured for serial communication with Arduino UNO. IR sensor is interfaced via interrupt pin 2 of Arduino UNO. All necessary connections are given to different motors for unreeling, cutting, sealing horizontally, pulling sheet and sideways sealing.

4. IMPLEMENTATION

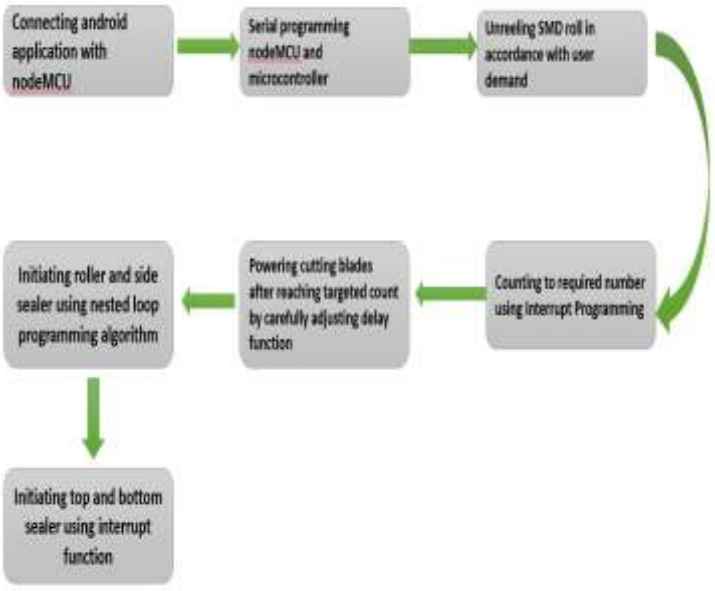

Fig 4.1: Process Flow

Initially the user selects the type of SMD component required and gives the count of that component he/she requires with the help of android application. All types of SMD components available in the device is mentioned in the android application to avoid any ambiguity for the user.

When the user submits the required count via application it is delivered to microcontroller via Node MCU ESP8266 WiFi module. Node MCU is connected to a specific WiFi network. From the android app the data is send to ESP8266 along with its local IP address as html code. At node MCU this data is separated from html codes so that only count is send to micro controller via serial programming.

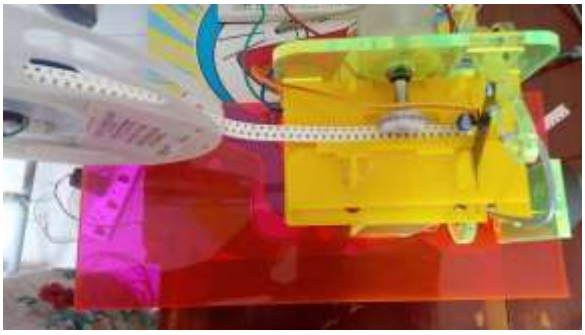

Fig- 4.2: Unreeling Gear

Microcontroller serially receives the value from node MCU. Using this data which is the demand made by user, unreeling motor is activated. To unreel closely packed SMD roll, a special gear is designed and fabricated. The gear is designed in such a way that its pitch is equal to distance between holes in the reel.

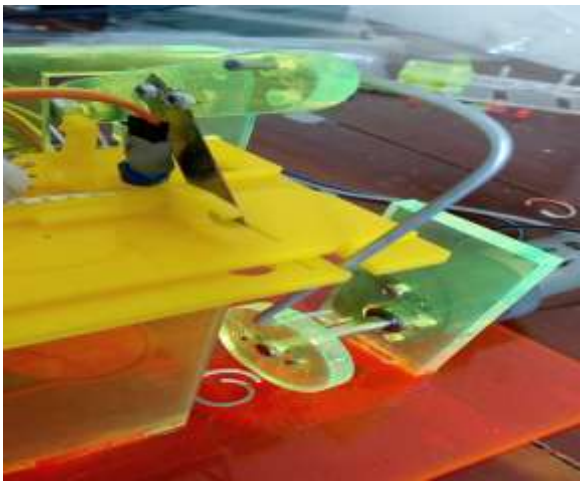

Fig 4.3: Cutting and Counting mechanism

IR sensor is used to sense the feeder holes present in the reel. Each component in the reel has a feeder hole near to it. Thus counting the number of holes gives count of components. To get accurate value of count, IR sensor is capped and focused thus allowing the light to pass through a very narrow hole This make fast and accurate counting of SMD components possible. After reaching the required count unreeling motor is turned off.

Once the SMD roll is unreeled, cutting mechanism is activated. Cutting is achieved with the help of stainless steel blades that are mounted on a support provided in the device. They are connected to motor shaft through a steel rod which gives up and down motion to the blade. A complete rotation of motor shaft gives a cutting movement to blade. This is done by adjusting delay and checking the rpm of motor used.

Fig 4.4: Packing Mechanism-Fan, Component collection box

The cut down SMD components fall into a box in the packing machine. The entire packing machine structure is made of PVC pipes since they are light weight and easy to organize. A box is provided so that components fall directly into the middle of plastic covers that are unreeled from both the sides of structure. Also a small fan is provided so that the covers do not stick together and components fall at the center.

Fig-4.5: Vertical Sealing mechanism

Then the plastic sheet is sealed on both sides using sealers. Nichrome wire is used as the heating element inside sealers. Both sealers are connected serially, so that both of them will get same amount of current to heat up. Sealers are provided with a separate power supply of less than 10 volt to avoid overloading and burning away of nichrome wire. But their time of switching ON is controlled by relay through proper coding of micro controller so that sealers are turned ON only when they are required.

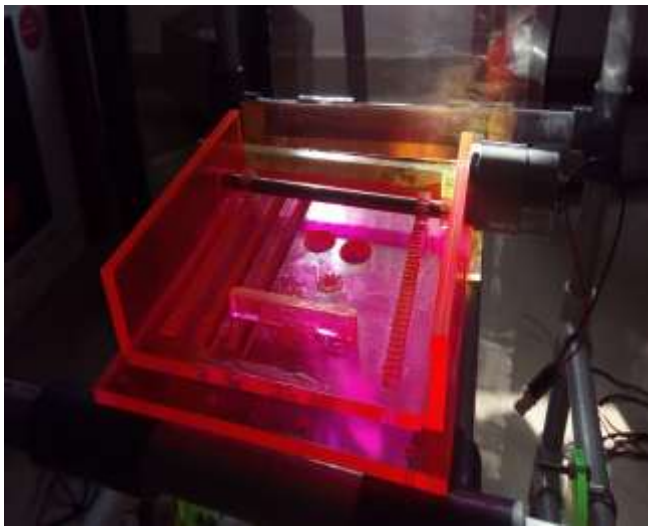

Fig-4.6: Horizontal Sealing mechanism

Horizontal sealing is done by using sealers made by winding a single layer of nichrome wire on thermoplastic. By mimicking the mechanism of a CD player disc inserter, there is a stationary nichrome winding part and a mobile nichrome winding part. The moving part moves forward to seal the cover horizontally and then moves back to old position. This sealing is done two times at predefined time intervals to seal the packet at the top and bottom portions. Here also sealer is given separate power supply to avoid overloading. Also activation time (for sealer to move forward and backward) is controlled by relay controlled motors.

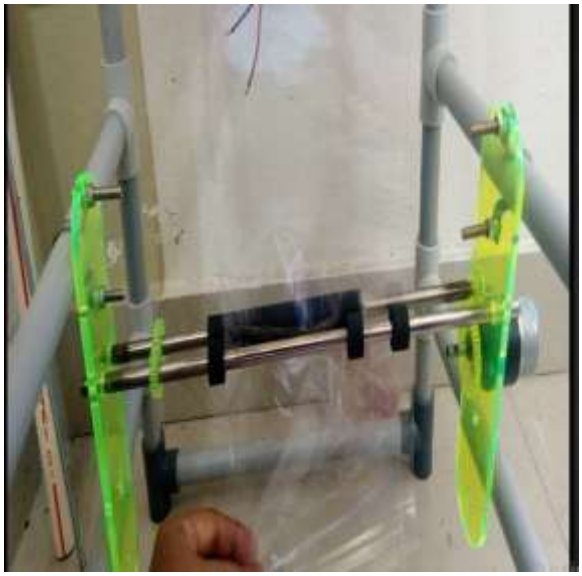

Fig-4.7: Roller

The backbone of complete packing machinery are these rollers. The entire packing process is possible because of the pulling action of these rollers .They pull down plastic sheets from both sides tightly, enabling side sealing to occur properly. Its working mechanism is imbibed from the rubber roller machines. The gears are designed likewise to pull down the plastic sheets. The activation time is controlled by programmed relays which control motors. Their switch ON time is made equal to that of the activation time of side sealers.

5. CONCLUSIONS

Smart SMD Packer is developed to smartly count, cut and pack SMD devices and hence saving valuable time, energy and resources. User is provided with a provision to choose the type of component and quantity of components of his/her choice via a user friendly android application. Depending on the demand made by the user, the required number of components are sensed through feeder holes in the reel and IR technology. After that they are cut down using cutting blades and then sent to packing machinery.
In packing machinery, the unrolling plastic covers pulled by the roller is sealed on both sides with cut down components inside the plastic sheet. They are sealed horizontally with a time gap to seal top and bottom. And finally user is provided by his/her requirement in sealed packets.

This project is very useful for packing industry as it reduces the human effort in counting, cutting and packing of SMD devices. The proposed device helps in saving resources, cost, time and labour. In labs, the requirement

of a lab assistant to sit and distribute components can be avoided, as by using the cutting and counting mechanism of the device one can get the required type and number of components accurately. Since this device has a mobile app associated to it, online shopping websites like Amazon can directly link device to users.

6. FUTURE SCOPE

At present the proposed device can hold only a single type. Adding type selectivity can be done easily with low cost .To make the device more informative reel labeling can be made. This will provide additional clarity on the type and number of component contained inside the packet. This makes it easy to sort/distribute packet without any ambiguity. At present packing mechanism is an independent unit that needs to be synchronized with microcontroller. Further improvisations on automatizing the entire packing mechanism would improve the working of device.

In the present world of data analytics, the demand of data is very high. Collecting data allows you to store and analyze important information about your existing and potential customers. So to the present system, cloud server can be linked to save the orders placed by the customers. This software changes can be done by programming without incurring any additional cost. Saving this data makes it easy for the providers to analyze which type of component is ordered more such that refill can be done accordingly.

An added feature of reel obsolescence control will increase the value and reliability of the system. It monitors the age of each reel and warns when a reel is approaching its end or has passed its use by date. This data if provided will help user to make a relevant demand always. This will ensure the stability of the device. Adding Artificial intelligence (AI) pattern-matching technology will help to detect faulty components. But adding this feature is very complex and reliability of its success cannot be guaranteed.

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