SMART SIZE SORTER AND COUNTING SYSTEM BY INTERNET OF THINGS

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Abstract: Design the automated sorting machine using conveyor belt to need the manufacturing industry in many fields is a very complex process. The system needs to develop in order to meet the industry satisfactions. This is an industrial automation based application. It shows the concept of normal conveyor belt, but with some intelligence. We can also call it as intelligent conveyor belt, as it has also ability to sort the object of different sizes. This helps to avoid size malfunctioning in production machines. In the core of the project, Embedded System (NodeMCU) and Internet of Things technology have been used. The NodeMCU is brain of the system and controls the relay and drives servo motor according to input from size sorting sensors. Ultrasonic sensors are used for detection. The objects of different sizes are passed through the sensors and the object having specified size is sorted. The belt is driven by drive circuit which is controlled by Push button. The internet of things technology provides the monitoring of the process and person can observe the count on smart phone. By developing such sorting system the production rate of the manufacturing industry has been increased since these sorting systems replaced the human resources.

Index Terms **– Internet of Things(IoT), Sorting and Counting.**

I. INTRODUCTION

The fruit and vegetable market is getting highly selective, requiring their suppliers to distribute the goods according to high standards of quality and presentation. In the last years, a number of fruit sorting and grading systems have appeared to fulfill the needs of the fruit processing industry. Present sorting systems tend to include the development of an electronic weight system and a vision-based sorting and grading unit which also measures size, with a friendly user interface that enables definition of classification parameters, reconfiguration of the outputs and maintenance of production statistics. Some commercially available systems are approaching this objective, but prices are becoming almost prohibitive for small and medium companies that try to maintain competitive levels. This is the case of many world fruit packing companies, which are usually small, agriculture products are quite price-sensitive, and they suffer from a hard competitive market. Thus, the idea was to build a new system integrating in a flexible way all parts (mechanics, control, weight and vision) of a fruit sorter. From the very beginning there was the criterion that the system should be conceived as an open platform ready to evolve and incorporate, without major changes, new requirements from the customers or simply an upgrade of any of its modules to avoid the obsolescence of its design or components.

Such Sorting system is extensively used in many industries like food processing industries, toy industries, etc. to ensure that the quality of the product is up to the mark. This process is simplified by the use of automation. Automation is the use of control systems like computers or robots for handling different process and machineries to replace a human being and provides mechanical assistance. Automated systems generally use more complex algorithms which increase the cost of the design and the power consumed. This not only reduces manual efforts, time consumed, gives more time for marketing, but also prevents danger which might occur when human beings work in hazardous environments. Automation greatly improves the productivity and is highly scalable. The purpose of this project is to save the time for inspection and to reduce the efforts of the workers in material handling.

An automatic sorting machine has main task of sorting components according to the sizes. This also consists of conveyor belt, which reduces the efforts of material handling. Also both processes take place simultaneously viz material handling and inspection. A sorting machine is more practical and economical method of automation, which transfers material from one point to another. The design is quite simple and of flexible use, means only conveyor belt can be used for material handling. Apart from the electronic system, mechanical system, Internet of things technology has also been added in which is adding new dimensions to sorting industry, Monitoring of Process, analysis of present things and based on that prediction can be done for future requirement and the can control the working process.

II. PREVIOUS WORK

Manual sorting is the conventional approach that is preferred by industries which involves visual observation performed by human beings. This is an approach where human laborers are made to work for maximum time to achieve the desired task. When we consider the large scale industries, segregation of objects that are bulk in number becomes a tedious task for laborers which consume lot of time. Recognizing a particular object and placing it in a required place is a tiring work, wherein one has to sort a bulk of objects with greater weight in quick time. This is slow and non-consistent when the human laborers do it manually. Sometimes humans are restricted to work in the hazardous conditions and it is the place where automation plays a major role.

Akinaga and Khoda (1982) developed a sorter in which sorting was done on the basis of dimension of the fruits and vegetables (e. g. length, width). Compared with manual sorting accuracy of the sorter was found to be satisfactory [1]. Hunter and Meyer (1958) studied apple sorting methods and equipment, i.e., sorting tables include one with a flat belt, one with longitudinal spiral rolls and one with reverse rotating rubber rollers moving over a plywood frame. Modification as the test proceeded included addition of sorting lanes, variables forward speed of rolls and ultimately a new design called the float roll table. The surface of this table consists of small rubber covered rolls extending across the table. The forward motion is controlled by varying the speed at which the rolls move down the table, and the rotating speed of the fruit is controlled by varying the rate at which the rolls rotate. The cost of labor for sorting a given amount of fruit was lowest for the float roll table and highest for the belt table. When sorting fruits of good quality, the relative efficiency of various types of equipment was apparent [3].

III. BLOCK DIAGRAM

The below block diagram consists of components like NodeMCU, Servo Motor, Ultrasonic Sensor and Dc Motor. The Ultrasonic sensor which act as the input to the processing NodeMCU unit and power supply is necessary for functioning of NodeMCU. Servo Motor angular movement help in the segregation of fruits. Ultrasonic Sensor help us in detecting small and big fruits.

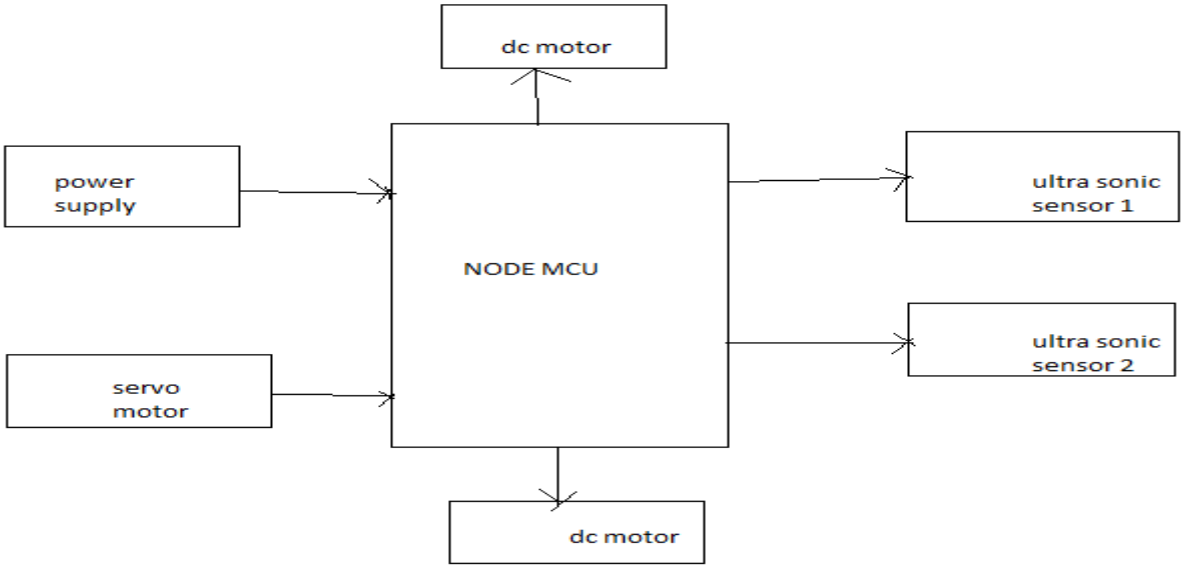

Figure 1: Block Diagram of Smart Size Sorter and Counting System.

A. NodeMCU

The NodeMCU (Node Microcontroller Unit) is open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only $2 USD a piece. That makes it an excellent choice for IoT projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. You have to solder wires, with the appropriate analog voltage, to its PINs for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. And, you have to program it in low-level machine instructions that can be interpreted by the chip hardware. While this level of integration is not a problem when the ESP8266 is used as an embedded controller chip in mass-produced electronics, it is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

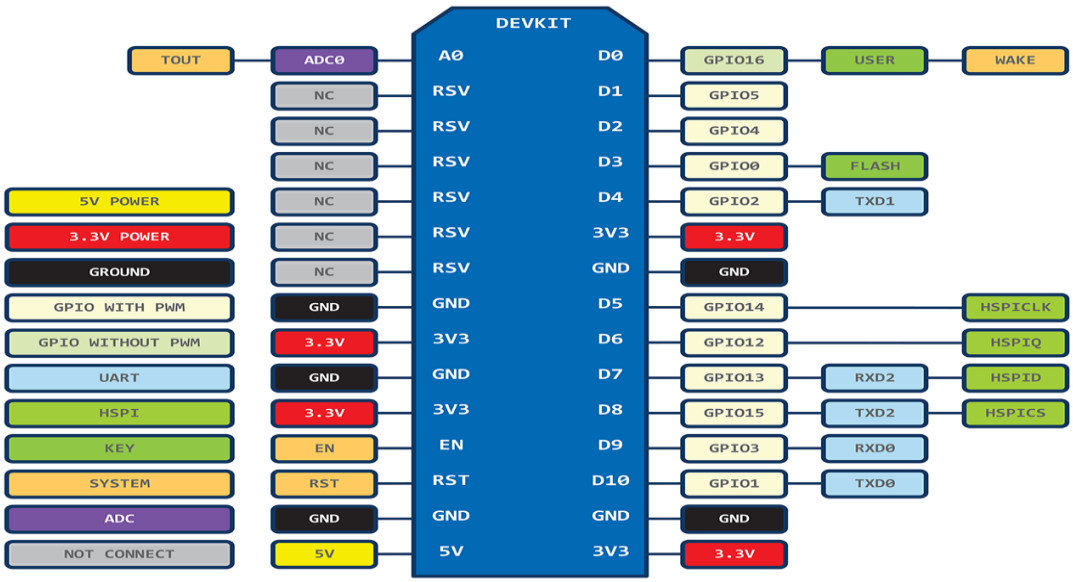

Figure 2: NodeMCU Pin Details.

Borrowing a page from the successful playbooks of Arduino or a Raspberry Pi, the NodeMCU project aims to simplify ESP8266 development. It has two key components. An open source ESP8266 firmware that is built on top of the chip manufacturer's proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community. For new comers, the Lua scripting language is easy to learn. A DEVKIT board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, Wi-Fi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board. The NodeMCU contains 13 general purpose input and output digital pins which is used as both input and output pins [2].

B. Conveyor

A conveyor belt consists of two or more pulleys, with a continuous loop of material which rotates over them. One or both the pulleys are powered, moving the belt and material on the belt forward. There are two main industrial classes of belt conveyors; those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport industrial and agricultural materials, such as grain, coal, ores etc.

C. Ultrasonic Sensor

Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. As the distance to an object is determined by measuring the time of flight and not by the intensity of the sound, ultrasonic sensors are excellent at suppressing background interference. Virtually all materials which reflect sound can be detected, regardless of their color. Even transparent materials or thin foils represent no problem for an ultrasonic sensor [4].

D. Servo Motor

A **servo motor** is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at some specific angles or distance, then you use servo motor. It is just made up of simple motor which run through **servo mechanism**. If motor is used is DC powered then it is called DC servo motor, and if it is AC powered motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. To these features they are being used in many applications like toy car, RC helicopters and planes, Robotics, Machine etc.

E. DC Motor

Almost every mechanical movement that we see today is accomplished by an electric motor. An electric motor takes electrical energy and produces mechanical energy. Electric motors come in various ratings and sizes. Some applications of large electric motors include elevators, rolling mills and electric trains. Some applications of small electric motors are robots, automobiles and power tools. Electric motors are categorized into two types: DC (Direct Current) motors and AC (Alternating Current) motors. The function of both AC and DC motors is same i.e. to convert electrical energy to mechanical energy.

IV. METHODOLOGY

The objects are fed to the conveyor at stipulated time intervals. This in turn initializes the DC motor which will move the object along the conveyor line. At the starting of conveyor belt we have fixed a stand and fixed two Ultrasonic sensors to it one upon another. The logic behind this is if both lower and upper Ultrasonic sensors having calculating distances is less than the width of conveyor belt then the object is determined as big and if only the lower Ultrasonic sensor having calculated distance less than width of conveyor belt then the object is determined as small.

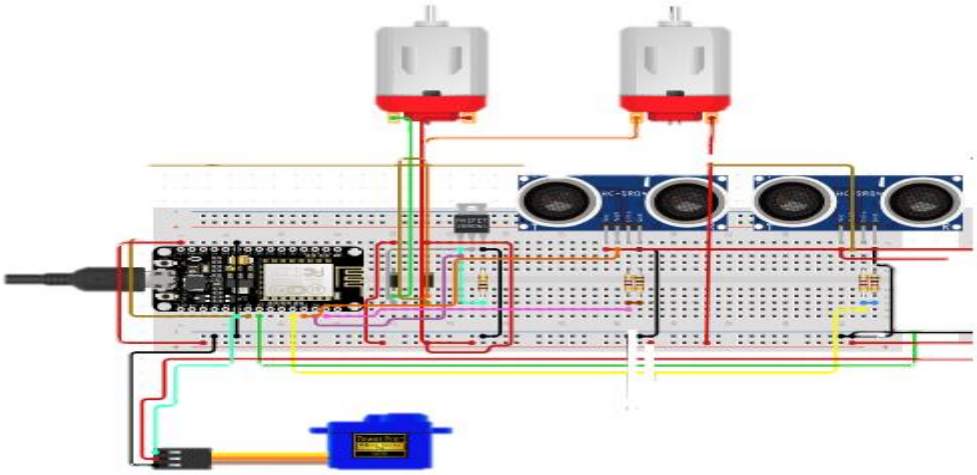

Figure 3: Circuit Diagram of Smart Size Sorter and Counting System.

At the end of the conveyor we have fixed a servo motor to divert the way of objects to their respective bins. We have placed two bins at the edge of conveyor at angles of 30 and 140 degrees respectively. If the object is small servo motor does not rotate and if the object is big then the servo motor rotates 90o. When servo motor does not rotates the long shaft attached to it diverts the way of object to bin of containing small objects. When servo motor rotates 90o the long shaft attached to it diverts the way of object to bin of containing big objects. Now the part of counting objects is based on the program written by us. We initialize two variables small and big as zero initially. Whenever both Ultrasonic sensors detect the object then big variable increments and whenever only lower Ultrasonic sensor detects the object then small variable increments. The NodeMCU microcontroller using in this project has inbuilt Wi-Fi shield named ESP8266. Using this Wi-Fi shield microcontroller will connect to Wi-Fi through username and password specified in program. Through Wi-Fi microcontroller will connect to Blynk cloud using the authentication token specified in program. After this we can see the device online in our authentication token related project in Blynk app. For this project we are using two value display widgets in Blynk one for small counter and one for big counter. We are sending the counter values of big and small variables to two widgets through virtual pins V2 and V3 respectively. By using the above process, we can monitor our production quantity from anywhere through internet. Internet of things technology helps for centralized monitoring of the entire process. Based on the statistics collected from process can be used for analysis and doing the prediction for business.

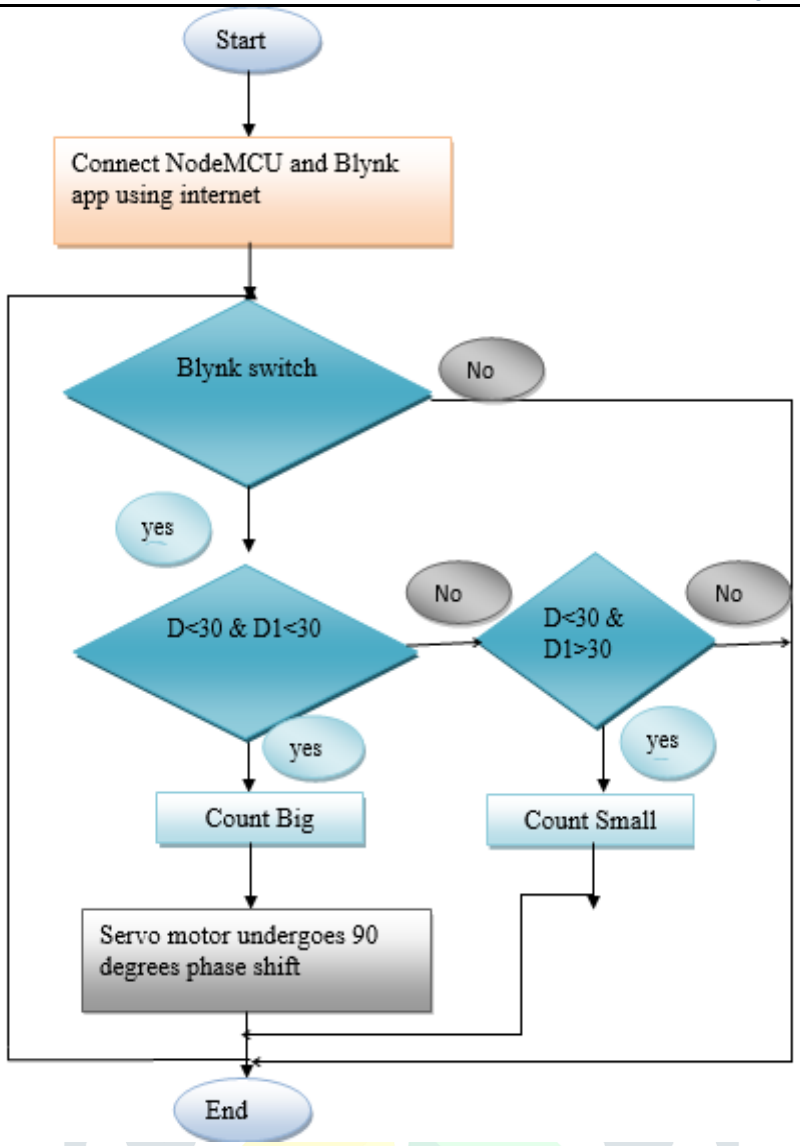

Figure 4: Flowchart of Smart Size Sorter and Counting System.

V. RESULTS AND DISCUSSION

The result of the smart size sorter and counting system can be observed on serial monitor appear in arduino software which is installed in system and another way of observing output is by using blynk app. By using this blynk application we not only observe the count of small and big objects but also control the system by switching ON or OFF even we are at distant places. On switching ON the system, the motor starts working and it makes the objects fall on the conveyor belt. While the objects are passing they are detected by the ultrasonic sensors placed and the count of small and big objects can be observed on the serial monitor.

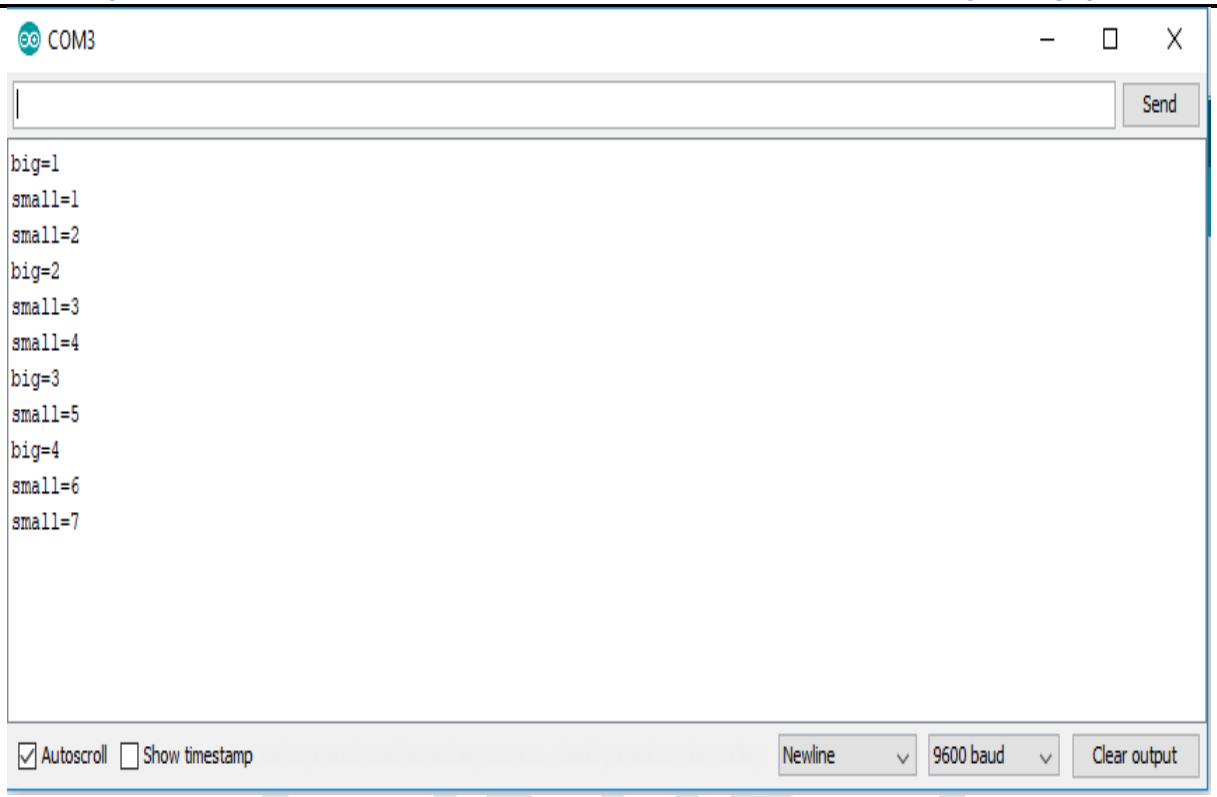

Figure 5: Output on Serial Monitor.

In the above figure, we observe that the first object detected is big i.e the object is detected at both ultrasonic sensors and since it is first big object the count of big object is given as '1'.The second object detected is small i.e the object is detected by lower ultrasonic sensor and since it is a first small object the count of small object is given as '1'.In the same process it continue and count of big object increases from 1 to 4 and final count of big objects becomes '4' in above example. Similarly the count of small objects increases from 1 to 7 and the final count of small objects becomes 7.

Now we are going to observe the output by using blynk application which is installed in android. Consider an example to observe the output of smart size sorter and counting system by using blynk app. In the below figure, we observe a button named SWITCH by pressing on that button we can make system ON or OFF even we are at distant places and the project name is appear at the top as sorting and count. In this we observe BIG and SMALL labels which are used for counting small and big objects. The value of small objects count is 8 and the value of big objects count small and big objects. The value of small objects count is 8 and the value of big objects count is 2.

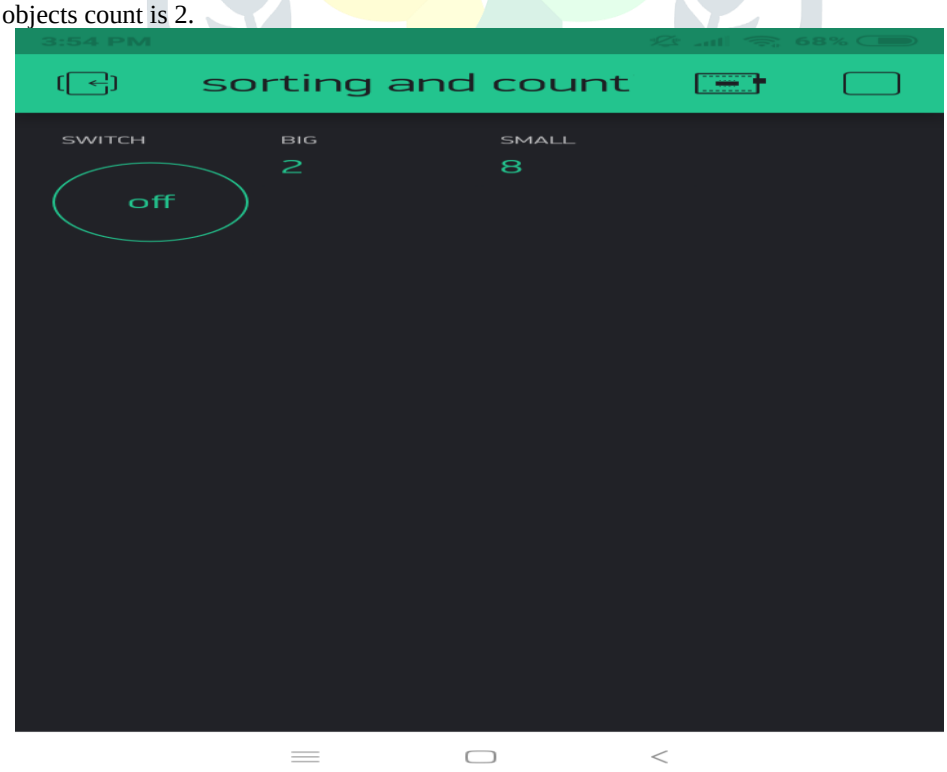

Figure 6: Output on Blynk App

VI CONCLUSION

Smart size sorter and counting system is IoT based system which is used for sorting of objects based on their size and also used for counting them. It monitors the counting and sorting of objects based on the data received from the ultrasonic sensors. Thing-speak and Blynk application is used to view those sensor data from remote location. With the help of Blynk app, notification service can also be added. The smart size sorter and counting system is built such that there is no need for human monitoring and enables automatic counting of objects whenever the object is detected and also help us in automatic sorting of objects based on their size. These detected values are printed on the serial monitor and also displayed in the blynk app when program is connected through the ESP 8266 Wi-Fi module.

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