Design of Gayo Arabica Coffee Pulper Based on the Internet of Things

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Abstract

Separating or peeling coffee fruit from its pulp is an important stage in producing coffee beans before dried under the sunlight. In Gayo highland, The Province of Aceh, UMKM M. Nur Hasan is one of producers or businessmen in processing gayo arabica coffee fruits to produce gayo arabica coffee beans. The ripe coffee fruits are purchased from local coffee farmers door to door. Unfortunately, the mill is still lack of coffee Therefore, in this research we as a team need to design the gayo arabica coffee pulper machine integrated with IoT in oder to serve the small business sector. The main components for the electronic system are Node MCU ESP8266, Weight Sensor Load Cell HX711 (capacity of 10 kg maximum), Module Relay, and Blynk. A mechanical frame is designed to support all required components. The design is constructed from both rectangular and U plates. Hopper is used for the entrance of coffee fruits to be pulped. In reading times (seconds) needed to peel gayo arabica coffee fruits, we use proximity switch sensor which detects the initial movement of the fruits poured into the hopper. The sensor is located on the base of the hopper. The smartphone application for this prototype is utilized the Blynk platform. These results indicate that the prototype sensors are linear with mechanical systems. Besides that, a real-time monitoring system is easy to use and more attractive because of smartphone utilization to monitor the process of gayo arabica coffee beans.

Keywords: Gayo Arabica; Coffee Pulper; IoT

1 Introduction

Indonesia is one of the tropical countries in the world that produces coffee beans. Coffee is one of the most popular drinks and is widely consumed because of its taste [1]. This fruit is one of the leading commodities for Indonesia's national income. Separating or peeling coffee fruit from its pulp is an important stage in producing coffee beans before dried under the sunlight. Coffee is not only consumed for refreshing drink, but also has the main role for their incomes economically. Coffee business sector has been inclining as a trend for highland farmers for decades. In order to reach the demand of coffee beans in the market, the coffee bean producers must have decent and advanced machine to work on it.

Automatic control technology that uses wireless connection have been increasing rapidly. Internet of Things (IoT) technology takes center stage to enable wireless

N. L. Husni et al. (eds.), *Proceedings of the 7th FIRST 2023 International Conference on Global Innovations (FIRST-ESCSI 2023)*, Advances in Engineering Research 232,
https://doi.org/10.2991/978-94-6463-386-3_34

equipment control through internet connectivity. New applications have been being developed unceasingly for automating, controlling, or monitoring peopel's dailiy needs in different sectors [2]. With the hotheaded growth of smartphones, wireless technologies have become an essential device today. IoT devices are non-standard gadgets that can wirelessly connect to a cloud and interchange data. This technology transforms the world into a smart world, where everything is readily reachable in less time and effort [3]. The integration of these gadgets allows us to monitor remotely and control as well as communication and interaction by relying on networks. In the IoT, physical substances which comprise sensors, software, and other technologies have the main function as minicomputers [4].

The production process that uses human power is quite dependent limited. People tend to want everything done quickly and use little human assistance in their daily activities [5]. Therefore this research makes an automatic coffee pulper as the theme of this research, to make it easier and faster for coffee bean producers before coffee bean dried under the sunlight and to be sold ultimately. So, it will not waste much time if an automatic coffee pulper is utilized. Based on these problems, the output of this research is to create a mechanical system integrated with Internet of Things (IoT) by designing and realizing an automatic coffee pulper machine supported the Arduino microcontroller.

Gayo or Aceh arabica coffee fruits is widely known both domestically and internationally [6]. The taste and acid content are quite different from robusta coffee. In Gayo highland, The Province of Aceh, UMKM M. Nur Hasan is one of many producers or businessmen in processing gayo arabica coffee fruits to produce gayo arabica coffee beans. The coffee fruits are purchased from local coffee farmers door to door. Unfortunately, the mill is still lack of coffee pulper machines to support their coffee bean export business domestically. Currently UMKM M. Nur Hasan's coffee mill has one coffee pulper only and 1,000 kg of coffee beans a day. In contrast, the area of the their land is potentially decent, 5,000 m^2. The lack of coffee pulper machine quantity has been the main problem is expanding the business capacity apparantly. Therefore, in this reseach we as a team need to design the machine based on IoT in order to help the UMKM M. Nur Hasan's business in producing gayo arabica coffee beans.

2 Methodology

Fig. 1 shows the block diagram of the prototype of the gayo arabica coffee pulper. The main components for this system are microcontroller, Node MCU ESP8266, Weight Sensor of Load Cell HX711, Module Relay, and Blynk interface.

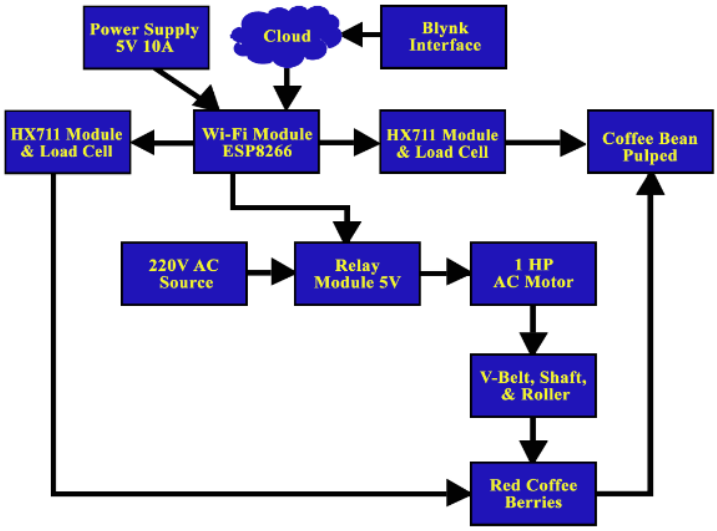

Fig. 1. Prototype block diagram.

A mechanical frame is designed to support all required components. The design is constructed from both rectangular and U plates. Hopper is used as the entrance of the pulped coffee fruit. The hopper is made of prism contour ST32 iron plate. A WiFi module of Node MCU ESP8266 is a good microcontroller for IoT development. The module is connected ot Arduino AtMega 2560, Weight Sensor Load Cell HX71, LCD display, and module relay. The Weight Sensor Load Cell HX71 has a weight measurement range from 0 kg to 10 kg and uses a 2V DC supply for its operation. In reading times (seconds) needed to peel gayo arabica coffee fruits, we use proximity switch sensor which detects the initial movement of the fruits poured into the hopper. The sensor is located on the base of the hopper.

Blynk is one of smartphone applications and an IoT platform that enables the development and implementation of smart IoT devices with ease and speed. With Blynk, all the sensor data can be observed in real-time easily from our smartphones, and the user can also give orders to the prototype [5]. Any equipments can be facilitated online because Blynk provides cloud services to exchange information between tools and users. The application has the main feature that is a controler that will measure the gayo arabica coffee bean produced and its time needed in a normal process.

3 Result and Discussion

Data collection using the prototype is shown in Table 1 for weight and time measurement of the coffee bean produced. The prototype was tested in the designed coffee pulper with the capacity of 2 kg/min and the machine dimensions of 110 x 40 x 35 cm^3 as shown in Fig. 2.

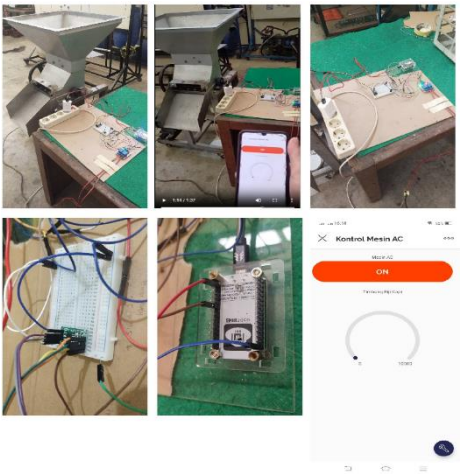

Fig. 2. The view of the prototype assemblied.

Table 1. Measured capacity of the Coffee Pulper equiped with IoT.

Test Run	Input of Coffee Fruit (g)	Output of Coffee Fruit (g)	Running Time (s)
1	1,000	730	42
2	2,000	1,410	83
3	3,000	2,180	118

The Coffee Pulper equiped with IoT designed has been tested for trice with the capacities of 1,000 g, 2,000 g, and 3,000 g. The first test (input 1,000 g) has shown that the coffee bean produced is 730 g and needs 42 s to process. The second one (2,000 g) has shown that the coffee bean produced is 1,410 g and needs 83 s to process. The final test (3,000 g) has shown that the coffee bean produced is 2,180 g and needs 118 s to process. Therefore, the IoT machine of coffee pulper will needs 1 hour to proceed and produce approximately 90 kg. If 720 kg of coffee fruit are input, it will need 8 hours to produce coffee bean.

4 Conclusion

Based on the results and analysis of the system that has been made, several conclusions can be drawn as follows:

1. The relationship between gayo arabica coffee fruit input and the coffee beans produced is linear within times to process.
2. The gayo arabica coffee pulper based on IoT will ease the users to control the running the machine and the coffee beans produced.
3. IoT technology surely can be integrated to conventional machine like gayo arabica coffee pulper.

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