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SMART FRUIT BASKET

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Abstract: Previous endeavors to minimize rotting of fruits has been retarded by the busy schedule of human beings that leads to forgetfulness. According to the Big 4 Agenda, food security is core and hence the need to ensure that food should not be left to rot due to forgetfulness on the side of human beings. Fruits that ripen before being eaten are very important to human beings because of their nutritional value. However, these fruits are considered to be perishable. Human beings tend to become busy and in the process can forget about these fruits, and therefore these fruits as a result end up rotting leading to huge losses to the owner. Studies that have been conducted previously indicate that practicing prudent reminder on ripening of fruits to busy people has reduced cases of food rotting. However, these studies never constructed a basket with an ethylene sensor that alerts the owner of the basket about the level of ripening of fruits. Therefore, the objective of this study was to construct and evaluate a basket with an ethylene sensor (gas sensor) that alerts the owner of the basket about the level of ripening of fruits. The data was collected from experimentation and from St Angela Sengera Girls' High School respondents, in Gucha town, Kisii County, Kenya. This study analyzed data using tabular and graphical analysis. Where the work of other authors was used, due acknowledgement was done. The researcher obtained a research permit from St Angela Sengera Girls' High school and Kenya Science and Engineering Fair in order to enable collection of data. The study concludes that the smart basket is a better method of detecting fruit ripening compared to detection through natural smell. This study recommends that the government implement this smart basket on a large scale basis so as to achieve the Big 4 agenda on food security by ensuring food does not rot, instead it should be eaten, preserved, sold or given to the hungry people in society.

Index Terms – Gas sensor, Arduino Uno microcontroller

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

According to Mahajan, Watkins and Geyer (2014), fruits that ripen before being eaten are very important to human beings because of their nutritional value. However, these fruits are considered to be perishable. Human beings tend to become busy and in the process can forget about these fruits, and therefore these fruits as a result

end up rotting leading to huge losses to the owner (Thompson, 2010). Technology has enabled human beings to construct equipment that can help remind them of their busy schedule (Gershuny, 2005).

Ariely and Wertenbroch (2002) argued that fruits are of different plant species, ranging from dry seeds capsules that burst to allow seed dispersal, to relatively large complex fleshy fruits that have evolved bright colours and developed gradually with aromas to attract seed dispersing bird and animals (Mahajan, Watkins & Geyer, 2014). These common events suggest that the underlying genetic mechanism that regulate fruits ripening may well be conserved between fruits of different species (Verbruggen & Hermans, 2012).

Fruits have been classically categorized into climacteric and non-climacteric based on increased ethylene synthesis which leads to color change and a concomitant rise in the rate of respiration during ripening (Bhushan, Yemane, Trudell, Overton & Goettert, 2007). From a scientific point of view, fruit ripening is a process in which the biochemistry and physiology of the organ are developmentally altered to influence appearance, texture, flavor, and aroma (Harren, Mandon & Cristescu, 2012). The fruit ripening process has been viewed over the last decades as being successively of physiological, biochemical and molecular nature fruit ripening is accompanied by a number of biochemical events, including changes in color sugar, acidity textures and volatiles (Gmachl, Curl & Capasso, 2010).

Color change is one major characteristic during the ripening of fruits and plants. (Thompson, 2010). The highly sensitive technique of laser photoacourtic spectroscopy coupled with the development of specific apparatus to determine plant color change in fruits and flowers of strawberry fruits during development has led to a concomitant rise in respiration rate in red-ripe strawberry fruits (Harren, Mandon & Cristescu, 2012).

1.2 Statement of the problem

Previous endeavors to minimize rotting of fruits has been retarded by the busy schedule of human beings that leads to forgetfulness. According to the Big 4 Agenda, food security is core and hence the need to ensure that food should not be left to rot due to forgetfulness on the side of human beings. As the fruit ripens the rot advances rapidly down the fruit stalks. A white or gray fungal growth may be present on the surface of affected

crowns. Fruits are affected by physiological, physical and biotic factors (Gershuny, 2005). Fruits like banana (Musa Paradisiaca) is one of the most commercially important tropical fruit in the world. Fruits are harvested at various stages of its maturity depending upon the purpose for which it's cultivated, such as culinary table purpose (Gmachl, Curl & Capasso, 2010).

Fig 1.1 Rotten fruits and people with a busy schedule

However, human beings tend to become busy due to day to day operations that occupy them hence leading to forgetfulness about fruits that are ripening (Ariely & Wertenbroch, 2002). Therefore, this study sought to construct a smart basket which can alert the owner of the basket by producing a beeping sound and a message on an LED screen if the colour of fruits changes hence avoiding the rotting of the fruits.

1.3 Objectives of the study

1.3.1 General objective of the study

To construct and evaluate a smart basket that will alert the owner on the color change when a fruit ripens using color sensing technology.

1.3.2 Specific objectives of the study

i. To investigate the rate of fruit ripening.

ii. To investigate the best method of detecting the ripening of fruits.

iii. To investigate how often people remember they have fruits stored for ripening.

1.4 Research Hypothesis

Colour change is the best method of detecting fruit ripening.

1.5 Research question

What is the best method of detecting fruit ripening?

1.6 Variables of the study

In the study, the independent variable is the time taken for fruits to ripen. The dependent variable is the method of detecting fruit ripening.

1.7 Scope of the Study

This study investigated the effectiveness of the smart basket on detecting the ripening of fruits. The study was carried out from the month of November to December, 2022 a period of two months. The study concentrated on the respondents available at St Angela Sengera Girls' High school, in Kisii County, Kenya.

1.8 Organization of the study

The study is divided into five chapters. Chapter one brings out the introduction to this study. This chapter will include the background of the study, the statement of the problem, the research objectives, the hypothesis, the significance, the scope and the limitations of the study. Chapter two will entail the Literature review of the study. Chapter three of the study will have the research methodology of this study. Chapter 4 will include the Data analysis and discussion while chapter 5 will entail the conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Empirical Literature Review

Mahajan, Watkins and Geyer (2014) investigated gas chromatography method and it was found to be more expensive and could not be able to detect ethylene gas. Various electrochemical devices had routinely been used in the past. Up comings in electrochemical sensor technology have expanded the application of these devices towards a wide range of compounds, including ethylene. An electrochemical sensor changes the concentration of a gas into a detectable physical signal such as electrical current. However, the current study sought to construct a smart basket with a ethylene sensor to detect the level of ripening of fruits.

Harren, Mandon and Cristescu (2012) conducted a study to investigate several types of sensors for monitoring fruit ripening. Ideally, a sensor should monitor ethylene quickly, be highly sensitive, with high selectivity and should be available at low costs. Unfortunately, such a sensor does not exist at the moment. Therefore the study suggested that it was important to review the application information carefully, before deciding on the best-

suited technology. Different applications required different solutions. If sensitivity and real-time analysis were required, laser-based sensors were considered. If less sensitivity and selectivity is needed, but portability is most important, ethylene sensors are recommended. However, if high sensitivity and selectivity is needed, but portability is most important, color sensors are recommended. The technical challenges for the future included the improvement of sensitivity, selectivity and measuring time. The current study sought to construct a smart basket with a ethylene sensor to detect the level of ripening of fruits since fruits ripened fast.

Gmachl, Curl and Capasso (2010) investigated the classification of sensors and concluded that they can be classified according to the physical change measured. When the measured quantity is current, the sensor is referred to amperometric sensors. Currently available amperometric sensors use anodes. When a voltage is applied between gold electrode and reference electrode, the color fastly oxidizes at the surface of gold electrode. This results to current change that is proportional to the concentration of ethylene gas. This study enhanced the study, by constructing a smart basket with a ethylene sensor to detect the level of ripening of fruits.

2.2 Summary of Empirical Literature Review

Fig 2.1 Summary of Empirical Literature Review

Author and Context of Study	Objectives	Findings	Knowledge gaps	Research gap filled by the current study
Mahajan, Watkins and Geyer (2014)	Investigated gas chromatography method	It was found to be more expensive and could not be able to detect ethylene gas.	Various electrochemical devices had routinely been used in the past. Up comings in electrochemical sensor technology have expanded the application of these devices towards a wide range of compounds, including ethylene. An electrochemical sensor changes the concentration of a gas into a detectable physical signal such as electrical current.	The current study sought to construct a smart basket with a ethylene sensor to detect the level of ripening of fruits.
Harren, Mandon and Cristescu (2012)	Conducted a study to investigate several types of sensors for monitoring fruit ripening.	Ideally, a sensor should monitor ethylene quickly, sensitive, with high selectivity and should be available at low costs. Unfortunately, such a sensor does not exist at the moment.	Therefore the study suggested that it was important to review the application information carefully, before deciding on the best-suited technology. Different applications required different solutions. If sensitivity and real-time analysis were required, laser-based sensors were considered. If less sensitivity and selectivity is needed, but portability is most important, electrochemical sensors are recommended. The technical challenges for the future included the improvement of	The current study sought to construct a smart basket with a ethylene sensor to detect the level of ripening of fruits.

			sensitivity, selectivity and measuring time.	
Gmachl, Curl and Capasso (2010)	Investigated the classification of electrochemical sensors and concluded that they can be classified according to the physical change measured.	When the measured quantity is current, the sensor is referred to amperometric sensors. Currently available amperometric electrochemical sensors use anodes. When a voltage is applied between gold electrode and reference electrode, ethylene diffuses into the sensor through the barrier.	This study did not use the sensors in real life applications	The current study sought to construct a smart basket with a ethylene sensor to detect the level of ripening of fruits.

CHAPTER THREE

METHODOLOGY

3.1 Material

i. Basket/ structure

ii. Color sensor/MQ2 Gas sensor

iii. Connecting wires

iv. Arduino Uno board

v. Buzzer & LED

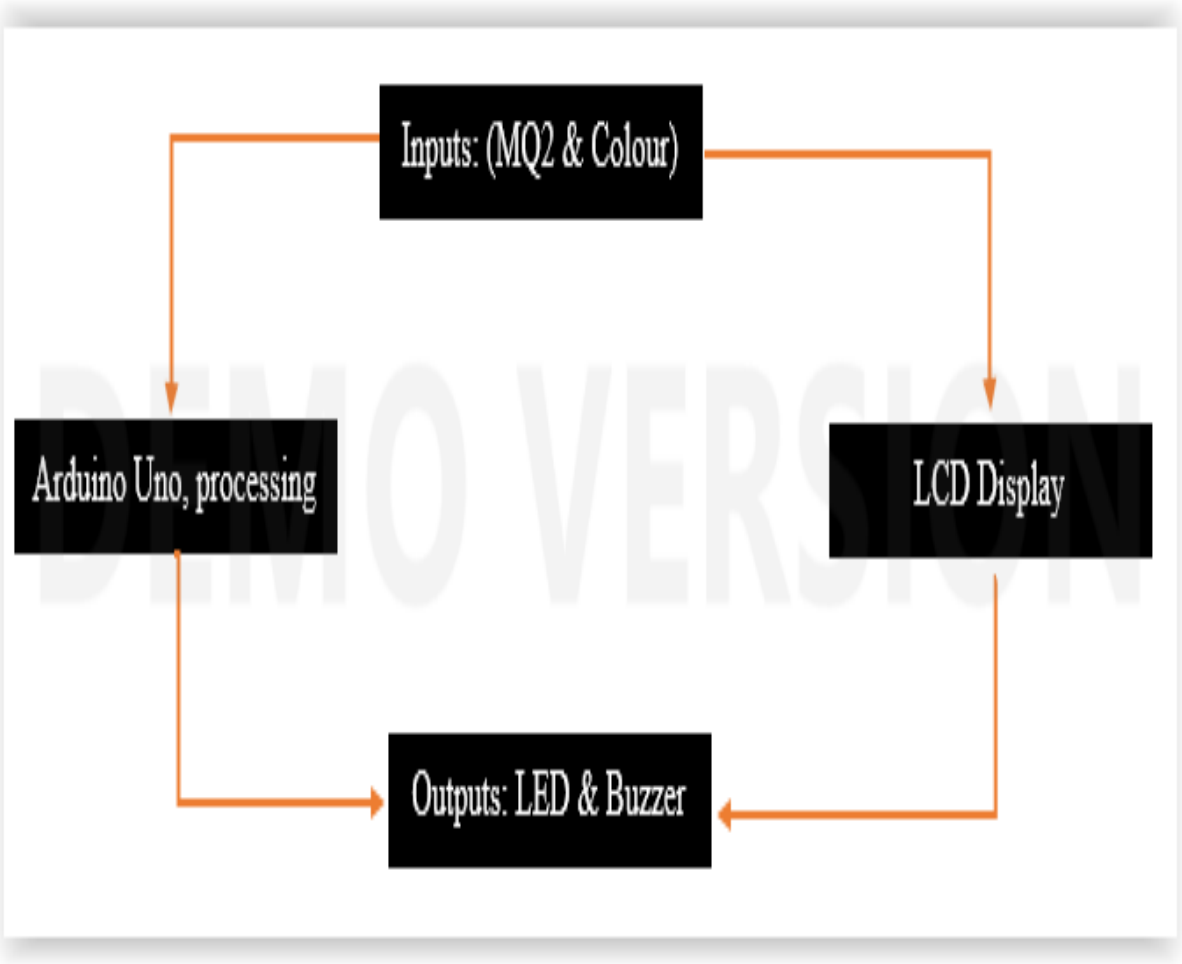
vi. Display unit

3.2 Procedure

- The basket or structure is where the fruits are kept as they are monitored.
- The ethylene sensor detects change in ethylene concentration of fruits. Most are green when unripe and red or yellow when ripe.
- Connecting wires allow connection between the components. To transmit both voltage and signals.
- The Arduino Uno board acts as the project brain. It reads sensor inputs to give a desired output.
- The LED and buzzers give an audio-visual output. LED's in terms of light while buzzers in terms of sound.
- The display unit/ Liquid Crystal Display (LCD) gives a visual representation of what goes on in the project.

3.3 Block diagram

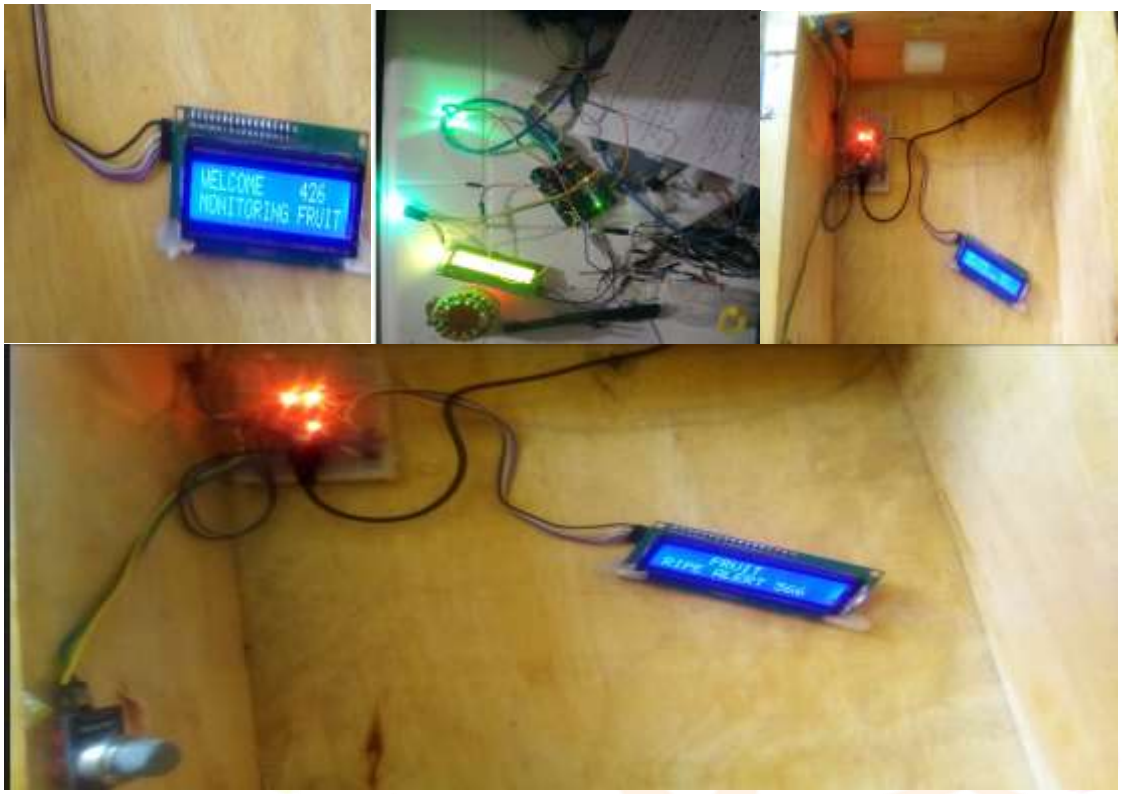
Fig 3.1 Block diagram



3.4 Observation

When ethylene accumulates in the set up due to emission of ripening fruits in an air tight container, an impulse is sent by the MQ2 sensor to the Arduino Uno. Once the Arduino receives this, it sends a signal to activate the LEDs and buzzers to alert the owner of fruit ripening. The LCD then displays words that insinuate a ripe fruit.

Fig 3.1 Smart fruit basket



3.5 Limitations and constraints

This study experienced the problem of inability to inform the owner of the basket when they are far away. The basket can only effectively inform the owners when they are nearby.

3.6 Merits

The basket will be of importance to food security, one of the Big 4 agendas of the government of Kenya. This is possible in that it will aid minimizing of the rotting of fruits by acting as a reminder to people about the ripening of fruits. This fruit will also be of great assistance to boosting the immunity of people given that fruits provide vitamin C.

3.7 Demerits

- Nearness is needed sometimes for the output to be effective. If there is a lot of noise, the gadget becomes inefficient.
- A lot of patience is required, it takes a long time depending on the color change. Some fruits may ripen before their color changes.
- Some fruits do not change color when they ripen.

CHAPTER FOUR

DATA AND DATA COLLECTION

4.1 Data collection

This involved a descriptive cross-sectional study of 10 respondents of St Angela Sengera Girls' High School. Data was collected through questionnaires, interviews and observation. Three types of unripe fruits which include banana, mango and orange were put in a basket without a gadget for ripening. The same number and weight of fruits was also put in the basket having the color sensor. The data obtained is as shown below:

4.2 Data analysis

Table 4.1 Number of days taken to change color when fruits ripened

Type of Fruit	**Number of days taken to change color when fruits ripened**
Banana	6
Mango	8
Orange	10

Table 4.2 Method of ripening of fruits for Banana

Method of detecting fruit Ripening	**Number of days**
Color Sensor	6
Smell	10

Table 4.3 Necessity of Smart Basket

Able to Remember Fruits one has kept for ripening	**Not able to remember Fruits one has kept for ripening**
3	7

Fig 4.1 Number of days taken to change color when fruits ripened

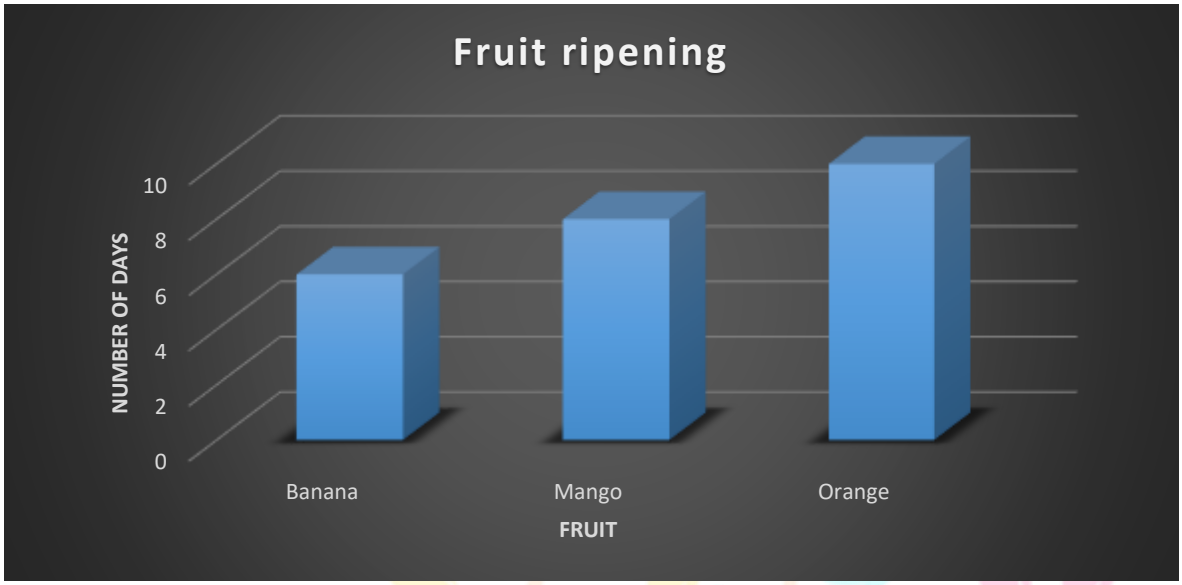


Fig 4.2 Method of ripening of fruits for Banana

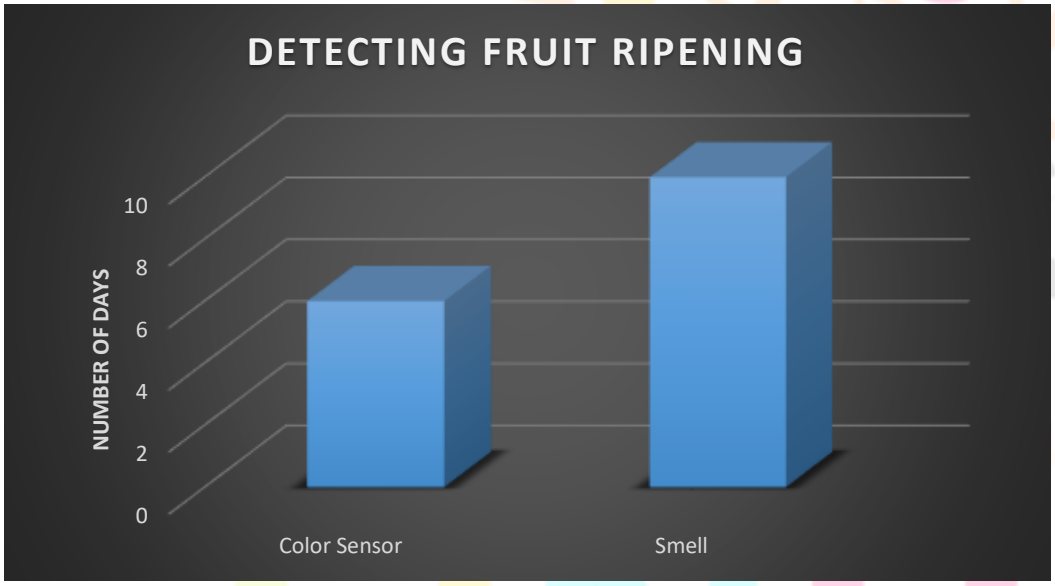
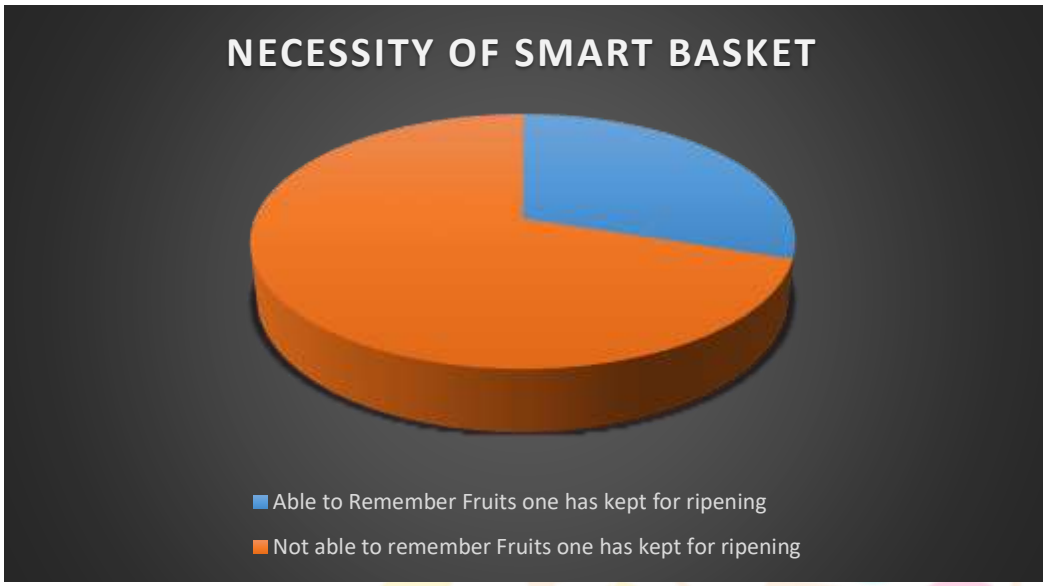


Fig 4.3 Necessity of Smart Basket



4.3 Data Discussion

From the results obtained in Table 4.1 and Fig 4.1, the number of days taken for fruits to ripen is different. The number of days taken for bananas to ripen is 6. The number of days taken for mangos to ripen is 8 while the number of days taken for oranges to ripen is 10. This therefore implies that bananas ripen faster compared to mangoes and oranges. Therefore, bananas were used in comparing the detection of ripening through natural smell and through the smart basket.

From the results obtained in Table 4.2 and Fig 4.2, the number of days taken for the ethylene sensor to detect the ripening of bananas is 6 while the number of days taken to detect the ripening of fruits through smell is 10. This therefore implies that the ethylene sensor takes the shortest time to detect the ripening of fruits compared to detection through natural smell.

From the results obtained in Table 4.3 and Fig 4.3, thirty percent of respondents were able to remember that fruits have ripened while seventy percent were not able to remember that fruits have ripened. This therefore necessitated the need to use the smart basket that can detect the color change of fruits hence informing the owner of the basket by producing a beeping sound and light.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

From the results observed in chapter IV above, bananas ripen faster compared to mangoes and oranges. Therefore, bananas were used in comparing the detection of ripening through natural smell and through the smart basket. The study also concludes that the ethylene sensor takes the shortest time to detect the ripening of fruits compared to detection through natural smell. The study finally concludes that the smart basket is a better method of detecting fruit ripening compared to detection through natural smell. With this data, the study has proved the hypothesis, answered all the research questions and achieved all the specific objectives.

5.2 Recommendations

This study recommends that the government to finance the implementantion this gadget on a large scale basis so as to achieve the Big 4 agenda on food security by ensuring food does not rot, instead it should be eaten, preserved, sold or given to the hungry people in society.

5.3 Future Directions

In future, we plan to improve the Smart Basket by putting SMS technology which will aid in informing the owner of the basket while they are away.

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APPENDICES

APPENDIX I: LETTER TO THE RESPONDENT

Dear Respondent,

I am currently a teacher at St Angela Sengera Girls' High School, Kenya. My Science club students are currently carrying out a research study on a project whose topic is:

"SMART FRUIT BASKET".

I therefore request for your information and cooperation in this exercise. All information will be treated with confidentiality.

Yours with regard

DR. DENNIS OSORO MARANGA

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