



**BUSITEMA  
UNIVERSITY**  
*Pursuing Excellence*

**FACULTY OF ENGINEERING  
DEPARTMENT OF COMPUTER ENGINEERING A  
TOMATO HARVESTING ROBOT**

**BY**

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**A PROJECT REPORT SUBMITTED IN THE PARTIAL FULFILLMENT OF THE  
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## APPROVAL

This is to certify that the project titled "Tomato Harvesting Robot" has been done under my supervision and is ready for examination.

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**DECLARATION**

I, **MUWAYA HUSSEIN**, do hereby declare that this project report is my original work and has not been submitted for any other degree award to any other university or institution of higher learning before.

Signature.....Muwaya Hussein..... Date 22-05-2019.....

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## **DEDICATION**

I dedicate this project report to my beloved parents Mr. Isala Abdul Karim and Mrs. Nabirye salima for the love and support they have provided to me throughout this project period, my sisters Nakirima Nuzhat, Naigaga Hasiina, and Ntono Fatuma, my brothers Muwaya sudiasi, Kirinze Sowali for the advice and financial support they rendered to me during the research period.

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## **LIST OF ACRONYMS**

<b>GSM</b>	<b>Global system for mobile communication</b>
<b>PCB</b>	<b>printed circuit board</b>
<b>IDE</b>	<b>integrated development Environment</b>
<b>PWM</b>	<b>pulse width modulation</b>

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## ABSTRACT

In Uganda, Tomato growing is increasing due to its benefits such as making tomato sauce and its application to many other kind of food which is so profitable as they are needed in many restaurants and home use. This increases country's economy as they are exported to the neighboring countries such as southern Sudan. However, the processes done during the growing of tomatoes are so tiresome, say spraying, harvesting etc., therefore, if not harvested in time with much care can cause a great loss to the farmers.

Currently used methods of tomato harvesting are not so effective and some of them cause damage to the tomatoes. This has caused a decrease in the country's economy and a loss to the tomato growers in Uganda.

In this system, a color sensor is used to detect the ripe tomatoes which eases the harvesting and also reduce on the time taken during harvesting and the ultrasonic used in the detection of distances between the obstacle and the system. A GSM module used to notify the farmer when the container used in the collection of the tomatoes is full, also when the robot has encountered an obstacle.

The methods used in the data collection were; use of the internet through articles and journals. Observations, here I moved to some areas where tomatoes are grown and observe the methods used in harvesting. Also interviews were conducted to a few individuals of tomatoes growers from eastern Uganda.

Harvesting is a major problem in agriculture; therefore I designed this system to help farmers during the harvesting period. This system is self-guided and can navigate through the garden without fail as long as tomatoes are plant rows and supported. This system is able to communicate with the farmer when the collection bucket is full by the use of GSM module.

Though my system is an intelligent system but still it has some limitations, therefore it won't help the farmers replace the container when it gets full. So in case the farmer delays to replace the system will stop harvesting and this will affect the performance of the system. I therefore recommend the advancement in technology where there will be some provisions for the robot to replace the container in case it gets full. I also recommend the use of solar as the source of energy and solar tracking system for the robot to receive enough power

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## **CHAPTER ONE: INTRODUCTION**

### **1.1 Background**

Tomato is an edible, often red, berry of the nightshade *Solanum lycopersicum*. Tomato is an annual crop that grows within two and a half to three months depending on the variety. Besides, its economic value to a farmer, it also has a great nutritive value where it is rich in vitamins C, A and B. This therefore solves some human health issues such as weight loss, obesity, eye disorders, morning sickness, and constipation. Tomato is also good for toxic cleansing. Tomato growing has contributed much to the development of Uganda since it's among the exports of the country, they are exported to the neighboring countries like southern Sudan and Kenya [1]. Tomatoes should be removed from the plant by gently twisting or rotating them in order to cleanly remove the tomato from the stem. Tomato harvesting is the process of removing ripe tomatoes from the tomato stock either by hands or using a system. Currently tomatoes are being harvested using hands in the developing countries such as Uganda. Developed countries like Japan, United States of America and China among others have attempted to automate tomato harvesting however, they may be challenging and costly for Ugandan [2]. These are due to factors such as poor farming methods, cost of the machinery and lack of skilled workers to operate the machinery [3].

In any production sector there is a growing need to increase the production and benefits while reducing time and costs. One major contribution in this direction is the development of automatic systems that replace manpower especially in tasks when a person performs worse than an automatic device in terms of precision, repeatability and working cycle [4]. Although, mechanical harvesters provide higher harvesting rate over traditional hand-picking harvesting methods, they have associated issues such as fruit quality, size selection and damage to the fruit tree [5]. Physical damage caused by mechanical harvesting to fruits not only halts the physical appearance of fruit but also degrades the fruit quality, hence need for an alternative system.

According to P. Li, S. Lee, and H.-Y. Hsu [6], machine harvesting decreases harvesting cost and increases the value of their product to the consumer. Conventional harvesting method is highly labor intensive and inefficient in terms of both economy and time. Machine harvesting systems are a partial solution to overcome these issues. They reduce the harvesting cost to about 35-45% of total production cost.

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