INFO20172 Final/Term Project

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| Due date: | April 12, 2023 |
| Group member names: | Utsav Kunjadiya  Svayam Modi  Kalp Patel  Pratik Sakhiya |
| Group Number: | 1 |
| The Professor’s Name: | Olga Brouckova |

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# Introduction

As per the given information, our group is going to make a project which will fit the given requirements. Discussing the case study, In the present time, it can be observed that farmers are facing lots of hurdles in harvesting, such as crippling shortages, high labour pay, weather conditions, work visas, transportation cost, fruit quality, health insurance for labourers, and so on.

The Flying Autonomous Robots, a product of Tevel, can solve the above-mentioned issues. This robot will be made of innovative technology and modern control algorithms that will make them able to pick with incredible accuracy and maneuverability. This robot will continuously collect all data for real-time harvesting. The Research and development have been done already, and the below features list and algorithm have been decided to use; Real-time harvesting data at your fingertips, AI perception algorithms, Vision algorithms, Maneuver algorithms, Balancing algorithms, and Harvesting optimization. Mr. Yaniv Maor, Founder, and CEO of Tevel is our sponsor, and the project is expected to start any day in March 2023 and will be completed within one year.

Discussing the team’s contribution, to begin with, the hardest part for us was to decide on a task for each member because in our group every member is an all-rounder such that everyone can do Documentation, Brainstorming, and many more. Once the tasks have been divided, every group member starts working on their task with full effort. Project Charter and Scope Statement have been allocated to Pratik and Kalp; and, Milestone report, Project cost estimate have been allocated to Utsav and Svayam. In the preparation of the Gantt chart, every group member contributed equally. Finally, the documentation was prepared by Pratik and Svayam with help of Utsav and Kalp.

# Project Charter

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| Project Title: Development of Flying Autonomous Robots  Project Start Date: March 2, 2023 Project Finish Date: January 26, 2024 |
| Budget Information: Mr. Yaniv Maor (Tevel’s Founder and CEO) has allocated $1,000,000.00 for this project. The majority of costs for this project will be internal labour, technology that is going to be used, manufacturing of robots, and many more. An initial estimate provides a total of 40 hours per week excluding unpaid mandatory breaks. |
| Project Manager: Cody Trembley, (437) 846-1594, cody\_trembley@tevels.com |
| Project Objectives: This company is going to build a new generation robot to solve lots of problems for farmers including agricultural waste, harvesting costs, fruit quality, work visas for workers, health insurance for labour, Transportation, facilities for labour, and many more. By creating this AI robot, it will simplify operations and reduce food waste. It will also be used for tracking the data number of fruits picked, quality, and geographical data. The main feature of this robot is durable and light in weight. It is designed in such a way that it will fly throughout the farm and pick the fruits from the trees without any damage to the fruits. This robot can harvest fruit between 50g to 700g from plants or trees. The team of AI developers is going to build an algorithm using the latest technologies for enabling accuracy and portability. Multi-tasking, various types of fruits, connection, and communication with multiple agricultural platforms are the main capabilities of the robot. |
| Main Project Success Criterion: The project will provide a solution that will help to meet all the needs of agriculture customers and be delivered within 1 year. |
| Approach:   * Collect the data from Research and Development team which has been done before the project started for execution. * Review internal and external templates and examples of project management documents. * Develop an algorithm in the robot to track the real-time harvesting units of fruits, the weight and size of each fruit, color grading, time stamping, geographical locations, and distributions. * Develop technology to perform multiple tasks such as the movement of the robot, picking of the fruit, and updating the real-time data. * Build a technology robot in such a way that it can be able to pick multiple fruits like apples, Kiwi, Oranges, and peaches from the trees. * Design a robot that can be able to take widths and row layouts from the user and start harvesting according to the data. |

## Roles and Responsibilities (Partial List)

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Role | Position | Contact Information |
| Yaniv Maor | Sponsor | Tevel’s, Founder and CEO | [yaniv\_maor@tevels.com](mailto:yaniv_maor@tevels.com) |
| Cody Trembley | Project Manager | Tevel’s, Manager | [cody\_trembley@tevels.com](mailto:cody_trembley@tevels.com) |
| Ann Cadger | SEO (Search Engine Optimization specialist) | Tevel’s, SEO person | [ann\_cadger@tevels.com](mailto:ann_cadger@tevels.com) |
| John Dafoe | Data Analyst | Tevel’s, Data Analyst | john\_dafoe@tevels.com |
| Waseem Singh | Senior Technical Lead | Tevel’s, Technical Lead | waseem\_singh@tevels.com |
| Wael Channa | Junior Technical Lead | Tevel’s, Technical Team Member | wael\_channa@tevels.com |
| John Wang | Agriculture Engineer | Tevel’s, Team Member | [john\_wang@tevels.com](mailto:john_wang@tevels.com) |
| Donald Trump | Megatron Engineer | Tevel’s, Team Member | donald\_trump@tevels.com |
| Rohan Patel | Quality Assurance Specialist | Tevel’s, Team Member | rohan\_patel@tevels.com |
| Jason Devdatt | Supply Chain Expert | Tevel’s, Sales | jason\_devdatt@tevels.com |
| Hardik Gohel | AI Engineer | Tevel’s, Development Team Leader | hardik\_gohel@tevels.com |
| Vraj Prajapati | AI Engineer | Tevel’s, Development Team Member | [vraj\_prajapati@tevels.com](mailto:vraj_prajapati@tevels.com) |
| Utsav Kunjadiya | Algorithm Developer | Tevel’s, Development Team Member | [utsav\_kunjadiya@tevels.com](mailto:utsav_kunjadiya@tevels.com) |
| Kalp Patel | Security Engineer | Tevel’s, Development Team Member | kalp\_patel@tevels.com |
| Pratik Sakhiya | DevOps Engineer | Tevel’s, Development Team Member | pratik\_sakhiya@tevels.com |
| Svayam Modi | Machine Learning Engineer | Tevel’s, Development Team Member | [svayam\_modi@tevels.com](mailto:svayam_modi@tevels.com) |
| Kevin Mitnick | Robotics Scientist | Tevel’s, Development Team Member | kevin\_mit@tevels.com |

# Scope Statement

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| **Project Title: -** Development of Flying Autonomous Robots  **Project Start Date: -** March 2, 2023, **Prepared By**: Cody Trembley, Project Manager, [cody\_trembley@tevels.com](mailto:cody_trembley@tevels.com) |
| **Project Summary and Justification: -** Mr. Yaniv Maor (Tevel’s Founder and CEO) requested this project for farmers in their farming by making new generation robots to solve a lot of issues that today’s harvesters are facing, such as agriculture waste, harvesting costs, fruits quality, and anyone problem-related workers. This project will also help to reduce expenses not only internally but also externally too. Also, it improves efficiency and accuracy in all tasks by providing cutting-edge technology robots. The budget for this project is $1,000,000.00 including $1,00,000 that will be needed for operational expenses that the project may require. Estimated benefits $2,00,000 each year. |
| **Product Characteristics and Requirements:**   1. **REAL-TIME HARVESTING DATA AT YOUR FINGERTIPS** 2. The "total amount of fruit gathered" refers to the total number of fruits harvested, whether by robots or humans. Farmers and orchard managers may watch the harvest's development and adjust the harvesting schedule as necessary by keeping track of this data in real time. 3. Each fruit's weight and size provide important information on the productivity of the orchard and the distribution of fruit sizes. Farmers can determine the most effective time to harvest particular areas of the orchard by analyzing this data to assess the effectiveness of their harvesting techniques. 4. Individual fruits are graded according to their color to determine how ripe they are. Farmers may make sure that they are picking their fruits at the perfect time, when they are fully ripe, by obtaining information on the color grading of fruits. This increases the harvest's yield and ensures the fruits are of the highest quality possible. 5. A timestamp is a record of the precise moment each fruit was picked. This information is useful for tracking the harvest's progress and making sure the fruits are collected as soon as possible. Farmers may ensure that harvesting is completed effectively and on schedule by monitoring the timestamp. 6. Geolocation data reveals the details of each fruit's precise location in the orchard. By collecting this information, growers can keep an eye on how the fruits are distributed throughout the orchard and modify the harvesting procedure as needed. This helps to make sure that the orchard is efficiently harvested throughout, increasing the harvest's yield. 7. The information that paints a full picture of the composition of each bin of harvested fruits is referred to as the distribution of weight, size, and colors in a bin. Farmers may assess the harvest's overall quality based on this data, and they can also decide how to sort and distribute the fruits according to their weight, size, and color. To guarantee that each box of fruits contains an even distribution of sizes, colors, and weights, this information may also be utilized to enhance the packaging and distribution process. 8. To find and follow various kinds of fruits in an orchard, these algorithms employ technology that simulates human eyesight. Moreover, they can pinpoint the location and degree of maturity of each fruit. Moreover, data fusion techniques are used to merge data from numerous sources, including cameras, LIDAR, and GPS, to provide a more comprehensive image of the orchard. 9. These algorithms recognize and classify different orchard items, such as fruits, leaves, branches, and weeds, using cutting-edge image processing technology. Fruits' size, shape, and color may also be evaluated, and their level of ripeness can be determined based on characteristics including color, texture, and hardness. 10. These algorithms make use of sensors to recognize the pressures the fruit-harvesting robot meets from the vegetation and maintain stability by balancing the robot accordingly. To make sure the robot stays upright, they take into account some variables, including the weight of the robot and fruits, the incline of the ground, and the wind conditions. 11. To increase the effectiveness of the harvesting process, these algorithms employ orchard data such as fruit location, maturity level, and yield. To maximize efficiency, they may tailor the quantity and placement of harvesting robots, the timing of the harvest, and the courses traveled by the robots. The algorithms consider a variety of factors, including worker availability, weather, and transportation costs. |
| **Summary of Project Deliverables: -**  **Project management-related deliverables:** Introduction, Project Charter, Scope Statement, Milestone Report, Gantt Chart, and Project Cost Estimate.  **Product-related deliverables: -**  **R & D Template:** This file will include the details of requirements organized according to the feature list that has been done by the R & D team.  **Robots Model Design Template:** This file will include details of how required parts in the robot will be structured and assembled as well as satisfy the needs of the required project.  **Algorithm Datafile:** This file contains information on developed algorithms that are required to complete the intended tasks with accuracy. In this file, the stored algorithms are as below mentioned.   * AI perception algorithms – fruit tracking and data fusion * Vision algorithms – detection of fruit, foliage, and other objects including fruit classification (size, ripeness) * Maneuver algorithms – optimal trajectory planning and execution. * Balancing algorithms – stabilization algorithms to balance the forces applied on the robot by foliage and fruit. * Harvesting optimization - fleet management optimization   **Cloud Storage and Database Model:** This model contains the schema of the database including tables, the relationship between tables, and the structure of cloud storage. Apart from it cloud servers, data centers, cloud deployment, cloud security, cloud migration, cloud workload, and cloud disaster recovery is included in this model that we will be using to implement this cloud service**.**  **UI/UX Model:** This model includes the wireframe design and mock-ups for the interface of the robot. This will be used for multiple platforms that have user-friendly layouts.  **Orchard Design Model:** This model has details about orchards including width, humidity, fertility, temperature, soil type, and fruit quality that will be used to improve fruit quality and maximize yield and profitability.  **Test Plan:** This will include documents and reports that will be produced as a part of the testing process. It also includes what issues occurred, and how these issues will be solved.  **Information security policies:** Procedures for managing access to information resources. This document will include User access control, Physical security, network security, and Application security to implement security. |
| **Project Success Criteria:** Our goal is to complete this project within one year by taking into account $1,000,000.00. The project sponsor Mr. Yaniv Maor has told us to focus on completing the project within one year as well as the accuracy of the robot. To fulfill these criteria, we must have an experienced team and powerful equipment. We must do a monitoring and controlling task to verify whether the machine is performing as intended and accurately or if there are any issues with the project will go a little bit longer. It will affect the cost too much because as early mentioned, the project must be completed within one year due to high demand. This project’s success affects the whole organization’s not only tangible benefits but also intangible perks too. |

# Milestone Report for Develop Flying Autonomous Robots

**Prepared by:** Svayam Modi, Date: 2023-04-05

Utsav Kunjadiya,

Pratik Sakhiya,

Kalp Patel

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Milestone | Date | Status | Responsible | Issues/Comments |
| Team Contract | March 22, 2023 | Completed | Utsav | No issues |
| Introduction | March 24, 2023 | Completed | Svayam, Pratik | No issues |
| Project Charter | March 27, 2023 | Completed | Kalp, Pratik | No issues |
| Scope Statement | March 29, 2023 | Completed | Svayam, Utsav | No issues |
| Project Cost Estimate | March 31, 2023 | Completed | Kalp, Utsav | No issues |
| Gantt Chart | April 3, 2023 | Completed | Kalp, Utsav, Pratik, Svayam | No issues |
| Milestone Report | April 5, 2023 | Completed | Kalp | No issues |
| Final Report | April 6, 2023 |  | Utsav, Pratik | No issues |
| Final Project Report Checking | April 7, 2023 |  | Svayam, Kalp | No issues |
| Project Submission | April 10, 2023 |  | Svayam | No issues |

# Project Cost Estimate

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Project Cost Estimate** | | | | | |
|  | **# of Units/Hrs** | **Cost/Unit or hr** | **Subtotals** | **WBS level 2 Totals** | **% of Total** |
| **WBS Items** |  |  |  |  |  |
| **1. Project Management** |  |  |  |  | **47** |
| **1.1 Initiation** |  |  |  | $1,631.25 |  |
| 1.1.1. Identify Stakeholders | 7.5 | $60.00 | $450.00 |  |  |
| 1.1.2 Develop Project Charter | 15 | $30.00 | $450.00 |  |  |
| 1.1.3 Hold a kick-off meeting | 20 | $36.56 | $731.25 |  |  |
| **1.2 Planning** |  |  |  | $20,058.75 |  |
| 1.2.1 Collect Requirements | 30 | $27.50 | $825.00 |  |  |
| 1.2.2 Plan scope management | 22.5 | $60.00 | $1,350.00 |  |  |
| 1.2.3 Develop Scope Statement | 15 | $60.00 | $900.00 |  |  |
| 1.2.4 Create WBS | 22.5 | $27.50 | $618.75 |  |  |
| 1.2.5 Define activities | 15 | $27.50 | $412.50 |  |  |
| 1.2.6 Sequence activities | 15 | $60.00 | $900.00 |  |  |
| 1.2.7 Estimate activity duration | 22.5 | $27.50 | $618.75 |  |  |
| 1.2.8 Develop Schedule Management Plan | 90 | $39.17 | $3,525.00 |  |  |
| 1.2.9 Develop a schedule | 45 | $28.75 | $1,293.75 |  |  |
| 1.2.10 Develop a quality management plan | 30 | $43.75 | $1,312.50 |  |  |
| 1.2.11 Develop a resource management plan | 60 | $43.75 | $2,625.00 |  |  |
| 1.2.12 Plan cost management | 45 | $45.00 | $2,025.00 |  |  |
| 1.2.13 Estimate costs | 7.5 | $30.00 | $225.00 |  |  |
| 1.2.14 Determine budget | 33 | $50.45 | $1,665.00 |  |  |
| 1.2.15 Plan risk management | 45 | $39.17 | $1,762.50 |  |  |
| **1.3 Execution** |  |  |  | $193,465.71 |  |
| 1.3.1 Define the required parts of the robot | 135 | $52.93 | $7,146.00 |  |  |
| 1.3.2 Design a model of Robot | 157.5 | $52.33 | $8,242.50 |  |  |
| **1.3.3 Multiple Agricultural Tasks** |  |  |  |  |  |
| 1.3.3.1 Gather information from R&D team | 14 | $36.38 | $509.25 |  |  |
| 1.3.3.2 Identify tasks | 84 | $38.69 | $3,249.75 |  |  |
| **1.3.3.3 Develop algorithms for each task** |  |  |  |  |  |
| 1.3.3.3.1 Develop AI Perception Algorithm | 225 | $55.68 | $12,528.75 |  |  |
| 1.3.3.3.2 Build Vision Algorithms | 300 | $53.26 | $15,978.75 |  |  |
| 1.3.3.3.3 Create Maneuver Algorithms | 225 | $57.92 | $13,031.25 |  |  |
| 1.3.3.3.4 Develop Balancing Algorithms | 300 | $47.56 | $14,268.75 |  |  |
| 1.3.3.3.5 Build Harvesting Optimization System | 300 | $43.44 | $13,031.25 |  |  |
| 1.3.3.4 Build database tables and schemas | 90 | $36.18 | $3,256.50 |  |  |
| 1.3.3.5 Create Data Structures, Functions and Iterative loops | 168 | $35.58 | $5,978.00 |  |  |
| 1.3.3.6 Develop storage for tracking records | 135 | $35.75 | $4,826.25 |  |  |
| 1.3.3.7 Build security system for records | 60 | $56.00 | $3,360.00 |  |  |
| **1.3.4 Picking multiple variety fruits** |  |  |  |  |  |
| 1.3.4.1 Create a list of fruits | 22 | $36.50 | $803.00 |  |  |
| 1.3.4.2 Gather details of fruits | 24 | $36.50 | $876.00 |  |  |
| 1.3.4.3 Create an algorithm for picking process | 148 | $51.38 | $7,603.50 |  |  |
| 1.3.4.4 Implement algorithm for harvesting fruits | 53 | $56.43 | $2,990.90 |  |  |
| 1.3.4.5 Develop a system for real-time recording of fruits | 108 | $43.52 | $4,699.80 |  |  |
| 1.3.4.6 Create database tables and schemas for harvesting records | 57 | $39.45 | $2,248.75 |  |  |
| 1.3.4.7 Develop a user interface to show fruit-picking records | 135 | $38.15 | $5,150.00 |  |  |
| **1.3.5 Multi Orchard Design** |  |  |  |  |  |
| 1.3.5.1 Gather data on types of orchard designs available from the R&D team | 7.5 | $45.25 | $339.38 |  |  |
| 1.3.5.2 Assess available area and accommodate number of orchards | 22.5 | $36.50 | $821.25 |  |  |
| 1.3.5.3 Develop an algorithm for finding the similar cultivation process | 210 | $52.41 | $11,006.25 |  |  |
| 1.3.5.4 Implement best orchard layout which maximizes yield and quality | 100 | $43.00 | $4,300.00 |  |  |
| 1.3.5.5 Develop a security algorithm for encrypting an algorithms data | 90 | $61.77 | $5,559.38 |  |  |
| **1.3.6 Multi-platform access** |  |  |  |  |  |
| 1.3.6.1 Build wireframes for the interface of an application | 54 | $47.61 | $2,571.00 |  |  |
| 1.3.6.2 Develop Mock-ups | 52 | $42.81 | $2,226.00 |  |  |
| 1.3.6.3 Create a schema for the database | 42 | $39.63 | $1,664.25 |  |  |
| 1.3.6.4 Develop front-end from Mock-ups | 105 | $42.25 | $4,436.25 |  |  |
| 1.3.6.5 Build backend with data analytics | 260 | $43.88 | $11,410.00 |  |  |
| 1.3.6.6 Deploy the app to the cloud platform | 12 | $40.13 | $481.50 |  |  |
| 1.3.7 Implement algorithms to the robot's model | 300 | $53.61 | $16,083.75 |  |  |
| 1.3.8 Test the product | 63 | $44.25 | $2,787.75 |  |  |
| **1.4 Monitoring & Controlling** |  |  |  | $203,355.00 |  |
| 1.4.1 View all generated logs | 350 | $34.25 | $11,987.50 |  |  |
| 1.4.2 Identify potential issues with an algorithm | 800 | $37.48 | $29,987.50 |  |  |
| 1.4.3 Monitor the process and accuracy of the algorithm | 800 | $37.48 | $29,987.50 |  |  |
| 1.4.4 Monitor the performance of an algorithm | 800 | $37.48 | $29,987.50 |  |  |
| 1.4.5 Integrate changes | 445 | $37.61 | $16,737.50 |  |  |
| 1.4.6 Maintain security standards | 1496 | $40.57 | $60,692.50 |  |  |
| 1.4.7 Correct the documentation according to the integreted changes | 350 | $34.25 | $11,987.50 |  |  |
| 1.4.8 All issues were solved and Documented | 350 | $34.25 | $11,987.50 |  |  |
| **1.5 Closing** |  |  |  | $1,124.25 |  |
| 1.5.1 Close project | 27 | $41.64 | $1,124.25 |  |  |
| **2. Hardware** |  |  |  | **66450** | **7** |
| Handheld Devices | 20 | 1200 | 24000 |  |  |
| Robotics Material |  |  | 30000 |  |  |
| Cloud Server | 6 | 2000 | 12000 |  |  |
| Internet | 3 | 150 | 450 |  |  |
| **3. Software** |  |  |  | **196465.7** | **22** |
| License software | 12 | 250 | 3000 |  |  |
| Software Development (Exec) |  |  | 193465.7 |  |  |
| **4.Testing (10% of Total Hardware and Software cost)** |  |  | **26291.57** | **26291.57** | **3** |
| **5. Training and Support** |  |  |  | **30610** | **3** |
| Trainee cost | 100 | 250 | 25000 |  |  |
| Travel Cost | 374 | 15 | 5610 |  |  |
| Subtotal |  |  | $739,452.23 |  |  |
| **6. Reserves (20% of Total Estimate)** |  |  | 147890.45 | $147,890.45 | **17** |
| Total Project Cost Estimate |  |  |  | $887,342.68 |  |