Product: DeliverED Home

Team: DeliverED

Abstract

This product aims to provide a convenient and safe way to accept deliveries while out of the house or without contact. The system consists of a tall, large mail box - that is securely attached to an outside wall - where delivered items can be inserted, handled with the utmost care and sanitised. Contents will only be accessible via the companion Android application. For a successful product we will conduct market research on already existing solutions, or those who share similar goals. From there we will identify what we can provide that our potential competitors cannot and who our demographic is. Concurrently we will research hardware and materials needed to perform the movement, locking and sanitisation functionalities, as well as protection from weather and brute-force entry. One aspect we must take precaution in is the sanitisation feature; extended research will be performed to ensure the safety of our users. After core functionality is completed and tested, we will continue onto development of 'quality-of-life' features that will improve user experience.

1. Goal description

Across the world, package theft remains a significant issue, and while some solutions do already exist, they largely involve travelling to public lockers - making them less personal, less accessible, and less secure. Our project aims to address these issues by creating a personal smart locker, which securely holds your items outside your own home, to enable safe and easy package delivery right to your door.

1.1. Relevance of the system

1.1.1. Market requirement

In 2016, August Home Inc. reported that nearly 11 million U.S. home owners had their package stolen within the past year. They reported that majority of the packages delivered to the customers' homes were stolen (74%) during the day, when the customers were not out, and it increased to 81% during the holidays. [9]

In 2019 C+R Research conducted a survey of 2,000 consumers in the U.S. who had shopped online at least once in the past 12 months. They found that 36% had experienced a package theft at least once. They report that the average cost of replacing a stolen item is $109. The average amount spent by consumers to prevent package theft was $191, through camera and motion light installations, putting up fences and gates, etc. [3]

Another survey of 562 participants from 49 states in the U.S. revealed that nearly 23.8% of the respondents had experienced package theft.[6]

It has also been reported that 12 million in Britain have fallen victims to package theft.[4]

It is evident from the statistics that there is a market need for a product that is able to safeguard parcels from getting stolen or otherwise damaged after delivery, while the consumer is not at home. Through our smart mailbox, we hope to provide an effective solution for the existing issue.

Due to lockdown measures and restrictions, the primary mode of purchase has shifted to online shopping. However, the popularity of online retailing was already on the rise before Covid-19.[8]

We have also included a sanitisation feature in our product so that consumers can avoid contamination through deliveries. Coronavirus appears to be able to survive on cardboard for 24 hours and for up to 3 days on plastic surfaces.[7] Our sanitisation feature will not only help protect our customers during the pandemic but also from other viruses, such as the flu virus. It is advised that deliveries be made contact free and be disinfected whenever possible.[10] 64% of consumers say that they are worried about their own health while 82% say that they are fearful for the health of others.[5] Our smart mailbox is able to address this concern through its UV sanitiser.

1.1.2. Existing market solutions

There is currently a product that addresses the concerns relating to package theft called 'myRENZbox'[1]. But it is targeted at commercial and residential building owners or office owners and not for personal use. The building owners need to provide it for its tenants whereas DeliverEd Home can be bought by an individual for personal use. Our design is also much more compact.

Another product, in this case meant for personal use, is the 'Smart Parcel Box'[2], which provides functionalities such as couriers being able to scan a unique bar code to record proof of delivery, having a separate locked and secure compartment within the mailbox for parcels, and delivery notifications being sent through email or text. However our solution takes this a step ahead. For example, we provide an app that is able to notify the user of not only deliveries but also if the door to the secure compartment has been left

open, among others. The app is also used to unlock the mailbox for package retrieval, as opposed to just a lock and key system, as is provided by 'Smart Parcel Box', which might be more susceptible to brute force, loss of access due to loss of key, etc.

Of course, our sanitisation option is another feature that differentiates our product from the others. To address the fact that some parcels may contain fragile items, we have added an internal scissor lift that raises and lowers a platform, so that such parcels do not just plummet down to the bottom of the mailbox and risk damaging the items.

With the growth in e-commerce, need for avoiding package theft and greater public awareness related to sanitisation, our smart mailbox is able to address the needs of the hour and of the future.

1.2. High-level description

Our smart mailbox has one primary use case – receiving and storing packages for later retrieval, as well as a few additional use cases that are dependent on extra functionality being implemented. The system consists of the mailbox itself, performing the mechanical operations and receiving instructions from the companion app, which gives the user all the functionality they need all in one place. The goal of the primary use loop is to ensure a safe and smooth delivery process for both the mailperson and the homeowner. An example of this primary loop can be seen below from the perspectives of two users of the mailbox.

User Story – Mail Delivery

Robert recently began working as a courier and operates on a tight schedule every day with many packages to deliver. He arrives at the next address on his list and carries their package to the door but finds that there is nobody at home. Robert notices the DeliverEd smart mailbox but is unsure of how to operate it. Thankfully, the device has a display with short and simple instructions on how to deliver a package. He simply places the parcel into the delivery area, and the mailbox notices the new parcel and displays a 'Deliver package' button on its front touchscreen. By just pressing the button, the parcel is safely delivered into the storage section and Robert can quickly continue on to his next address.

User Story – Mail Retrieval

The Smith family live in a residential street that is unfortunately prone to package thefts and purchased a DeliverEd mailbox. They have made plans to leave home for the day and are expecting packages during this time. Whilst out, the family receive a notification confirming that two packages have been safely delivered into their mailbox where they are kept secure from theft. Once returned, one of them opens the DeliverEd app which displays the current package count and storage capacity, and at the press of a button they are able to open the secure section of the mailbox and retrieve the two packages.

These stories encapsulate the core function of the DeliverEd mailbox, but there are many different additional cases that we are looking at addressing once this functionality has been implemented:

User Story – Security Reminders and Family Use

One of the children of the Smith family was eager to retrieve their package and forgot to fully close the secure section of the device. The companion app displays a warning in this case, but unfortunately it goes unseen. After a user-defined period of time a notification is sent out to all trusted users of the mailbox informing them of the open section, giving the whole family notice. The door is then closed, and security maintained. Trusted users can be set up inside the app, allowing for the whole family to be able to use the device with ease, and for situations like this to be quickly solved.

User Story – Package Disinfection

There has been a local outburst of Covid-19 around the Smith family home. They are concerned over their packages and prior to purchasing their new mailbox had been keeping them quarantined for a couple of days just to be safe. Thankfully, DeliverEd has the ability to sanitise packages via a UV emitter inside the secure section of the device. The mailbox keeps track of which packages have been sanitised, which is displayed on the app. If a sanitisation is in progress when they open the secure section, it is immediately halted to ensure safety. After a few months, the local outburst is over, and the Smith family are able to disable or enable the sanitisation option whenever they please.

User Story – Not Expecting Packages

The Smith family are planning a two-week holiday abroad, during which they are not expecting any packages. Their DeliverEd mailbox can be of assistance here too, and they decide to go into the app's settings and tick the 'Lock Mailbox' option. This ensures the device does not accept new packages, displaying a custom message if someone tries.

User Story – Facial Recognition

One of the Smith family kids has lost his phone and fears it may have been stolen. Thankfully, the DeliverEd app is protected via the inbuilt facial recognition technology of the smartphone, so if a third party were to gain access to the phone, they would be unable to use the app.

2. Task planning

2.1. Milestones

Our milestones are illustrated in Table 1 at the end of the document.

2.2. Task decomposition

Our task decomposition is illustrated in tables and a Gantt chart at the end of the document.

See Table 2 for hardware task decomposition at the end of the document.

See Table 3 for software task decomposition at the end of the document.
See Table 4 for design task decomposition at the end of the document.
See the final page for the Gantt chart.

2.3. Resource distribution

Our resource distribution (hours, skills and equipment) is illustrated in Tables 6 and 7 at the end of the document. Figure 1 is the resource distribution of the group.

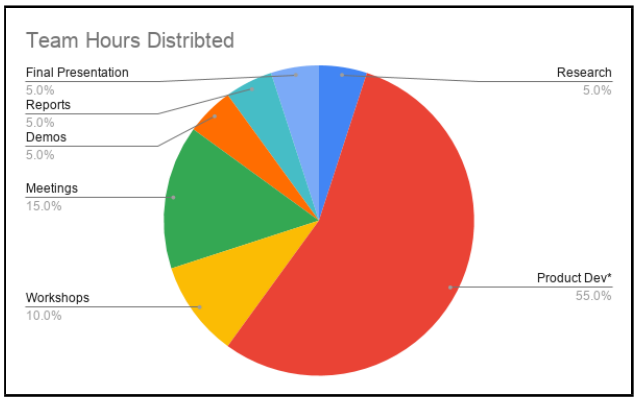


Figure 1. Team Hours Distributed

*Product Dev** Sub Tasks: Software Front-end, Software Back-end, Webots Simulation, Design and Testing.

2.4. Risk assessment

Our risk assessment is illustrated in Table 5 at the end of the document.

3. Group organisation

Name	Roles
Neo Zhu	Hardware/Webots Simulation
Huacheng Song	Design, Software Engineer
Chris Perceval-Maxwell	Design, Software Engineer
Harry Lennox	Software Engineer
Hrichika Nag	Hardware/Webots Simulation
Amy Rafferty	Design, Software Engineer
Hallelujah Kebede	Software Engineer
Yizhuo Yang	Software Engineer

3.1. Meetings: Our group uses *Microsoft Teams* to take meetings. Our group has a meeting every weekend, where we summarize the tasks of the coming week and determine the direction of the discussion. In addition, good ideas and opinions in the group are often obtained through meetings. When each meeting ends, the time for the next meeting will be fixed. We will also meet a few times before a deliverable to discuss it and ensure the current demo is in good progress. Other smaller meetings between the individual teams such as app development and Webots can take place whenever necessary.

3.2. Communication: Our group uses *Microsoft Teams* and *Messenger* to communicate with each other. Our group members all have personal *Facebook* accounts, hence we decided to use Messenger. Every day we have about at least 3 hours of meeting time. Excluding these meeting times, if members of the group have good ideas, they can use Teams or Messenger to communicate within the group. This can make use of free time and provides communication before meetings to determine the content of the meeting, which can greatly improve their efficiency.

3.3. Code-sharing: Our group use *GitHub* and *Git* to manage our Software. The code of team members can be well managed through GitHub and Git. GitHub has a very key function called Organization whose advantage is that it can be managed and authorized in a unified way.

3.4. Task allocation: After each meeting, we will assign everyone their weekly tasks. We break down the project into small tasks and ensure all group members are confident with their jobs. We can have meetings to communicate if anything needs to be adjusted.

3.5. Progress tracking: Our group uses *Trello* to track our progress. This allows us to keep track on where individual parts of the project are at, and acts as a preventative measure to avoid teams falling behind and last minute design changes as detailed in our risk assessment. It also helps to visualise how much work is remaining until a milestone is achieved. We can incorporate an AGILE development methodology, using columns To-do, In p

Milestones (Table 1):

Milestone	Notes	Deadline	Evidence
Design App UI	Design and overview of desired functionalities and dependencies	Demo 1 (3rd February 2021)	Sketches of page designs, page mapping, notifications, list of hardware dependencies
Market research	More focused on similar solutions and how our design is better	Demo 1 (3rd February 2021)	Slide/Document showing a comprehensive list of statistics supported by trusted sources, competitors, and differences between our design and others
Basic Webots simulation	Device structure and partitions	Demo 1 (3rd February 2021)	Presentable demo video of the basic principles of our design
Design hardware model for review	Functionalities, materials, sensors – diagram sent to Gary for review	Demo 1 (3rd February 2021)	Full sketch, sent to hardware specialists
Design Website UI	Design and general idea of what information we need to be recording during the project	Demo 2 (3rd March 2021)	Presentable basic website with blank areas for future information, page sketches and page mapping
Implement basic app functionalities	Functionality for opening device door, error messages (elevator or dividing door stuck), device connectivity (method TBD)	Demo 2 (3rd March 2021)	Presentable app showing the client user interface and door functionalities
Webots simulation – physical factors	Add dividing floor, scissor elevator, opening and locking mechanisms	Demo 2 (3rd March 2021)	Presentable demo video in Webots showing functionalities
Webots simulation – vision and sensors	Add cameras, weight sensors, infrared sensors	Demo 2 (3rd March 2021)	Presentable demo video in Webots showing functionalities
Physical hardware – testing the simulation	Assuming that our device has been physically built at this stage, send tests to the manufacturing team to run, to ensure the code we run on our simulation also applies to real life. If build not completed, change deadline to Demo 3	Demo 2 (3rd March 2021)	Documentation from the manufacturing team
Backend webots/app connectivity	Webots sensors trigger alerts in app	Demo 3 (17th March 2021)	Demo video showing the link between a triggered sensor in webots and a notification showing up on an app
Webots simulation – extra functions and testing	UV sanitation, security measures Thoroughly test mechanisms in simulated form	Demo 3 (17th March 2021)	Demo video showing UV lighting for correct durations, and of tests run and their outcomes
Updated website	Include all relevant information to website gathered thus far	Demo 3 (17th March 2021)	Presentable website that is visually more complete than the demo 1 presentation
Physical hardware – further testing	Continue sending updated simulation code to be tested on real-world device.	Demo 3 (17th March 2021)	Documentation from manufacturing team.
Completed website	Website fully updated with information from throughout the project, ready to present	Demo 4 (31st March 2021)	Presentable website, completed with a review and updated Gantt chart
Completed app	Fully functional app with webots and physical device connectivity	Demo 4 (31st March 2021)	Presentable app with demonstrable effects on our device
Full webots simulation	All errors brought up by testing fixed, fine-tuning of functionalities as needed	Demo 4 (31st March 2021)	Demo video showing off all functionalities of our device, and its use via the app as explained above

Completed physical hardware	Should have a fully functional and tested device, or if not, a mostly tested device waiting on some response from the manufacturing team.	Demo 4 (31st March 2021)	Demo video from the manufacturing team of the device in action, showing off all functionalities and app connectivity.

Hardware Task Breakdown (Table 2):

Task	Milestone	Hours	Dependency	Description
Initial MailBot Shape Design	Basic Webot Simulation	5	None	Design the appearance of the MailBot
Add parcel entrance	Basic Webot Simulation	5	None	Provide an entrance for delivery staff to drop parcels
Add parcel exit	Basic Webot Simulation	5	None	Provide an exit for customers to collect parcels
Research on proper material	Design hardware manufacturing model	10	Consulting Hardware Specialists	Research on materials, sensors needed for all functionalities
Add Dividing Floor	Webot Physical Factor Simulation	5	None	Create a dividing compartments for sanitation and storing
Add Scissor-Lift	Webot Physical Factor Simulation	10	None	Creating a mechanism to transport parcel inside MailBot
Add Locks	Webot Physical Factor Simulation	5	None	Creating Opening and Locking mechanism to protect parcels
Add Camera	Webot Vision and Sensor Simulation	5	None	Adding camera for parcel and facial recognition
Add Weight Sensor	Webot Vision and Sensor Simulation	5	None	Adding weight sensor to record the mass of a parcel for reference
Add Infrared Sensor	Webot Vision and Sensor Simulation	5	None	Add infrared sensor for distance measurement reference
Sensor data behaviour analysis	Basic Functionality Simulation Testing	10	Simulation Building Successful	Simulate real-life scenario to test the MailBot for basic functions
Add UVA Light	Webot Extra Function Simulation	5	Basic functionalities works well	Adding UVA light to add sanitization function for parcels
Add Double Security Measures	Webot Extra Function Simulation	5	Basic functionalities works well	In case of emergency or user lost phone, MailBot can still open
Communicate with hardware specialists for hardware testing	Physical Hardware Verification	10	Hardware specialists delivered build based on simulation	Continue sending updated simulation code to be tested on the real-world device.
MailBot Local Functionality Testing	Full webots simulation	10	Simulation Building Successful	Test if functionalities of the webot simulation works fine
MailBot Interaction Testing	Full webots simulation	10	Simulation Building Successful	Test if App can successfully control the MailBot simulation
MailBot Local Functionality Testing	Full hardware testing	10	Physical hardware and time are available	Test if functionalities of the physical mailbot works fine
MailBot Interaction Testing	Full hardware testing	10	Physical hardware and time are available	Test if App can successfully control the physical Mailbot

Software Task Breakdown (Table 3):

Task	Milestone	Hours	Dependencies	Description
Design app structure and functionality	Implement basic app functionalities	5	Design visuals	Plan the layout and design of the app from a visual and technical perspective. This includes figuring out communication between the app and device.
Familiarise with Android Studio and Kotlin	Implement basic app functionalities	6 (gradual improvement)	None	Get used to working with the editor and technology. This will continue throughout the project.
Establish connection between app and device	Implement basic app functionalities	6	Design app structure and functionality, Milestone: Basic Webot Simulation	Create the link between the interface and the device, for now represented in Webots.
Create basic app interface	Implement basic app functionalities	5	Design app structure and functionality	Follow the agreed design but with default resources to create a main screen with a button to open the door.
Open the door	Implement basic app functionalities	4	Establish connection between app and device	Using the connection, send a signal from the app whenever the button is pressed which opens the door on the webots simulated device.
Receive sensor input	Backend Webots/App Connectivity	4	Milestone: Webots Simulation - Vision and Sensors	Use the established link to receive alerts from the device and store these in a useful format.
Generate notifications	Backend Webots/App Connectivity	4	Recieve sensor input	One sensor input is being received and sanitised, use this to generate correct push notifications.
Display number of packages inside device	Backend Webots/App Connectivity	15	Milestone: Webots Simulation - Vision and Sensors	Track the number of parcels put into the device to display it on the app. This will require code on both the app end and device end.
Multiple trusted users	Completed App	15	Establish connection between app and device	Allow a user to set up multiple access to the device, so that anyone in the group can open the mailbox and receive notifications.
Testing of app-device functionality	Backend Webots/App Connectivity	10	All previous	Perform testing on everything done so far to ensure minimal bugs in the basic loop of function.
Display current santisation status of parcels	Completed App	10	Milestone: Webots simulation – extra functions and testing	Keep track of which parcels have been sanitised inside of the device and display on the app.
Sanitisation safety measures and UV movement	Completed App	10	Milestone: Webots simulation – extra functions and testing	Allow the UV device to move in order to ensure all packages are sanitised, and stop the UV if the door is opened.
Facial Recognition	Completed App	6	None	Add facial recognition check to the app startup to ensure only the user can access.
Lock Mailbox	Completed App	10	Milestone: Webots simulation - physical factors	Add the ability to lock the delivery section of the mailbox from the app.
Final Testing Period	Completed App	10	All previous	Perform some final tests on every area of the app, ensure maximum possible coverage. Ensure things are solid both on the app and device end.
Basic Device Functionality	Completed Physical Hardware	8	Hardware has been assembled	Create the code in the device responsible for opening the door on a signal.
Package Detection	Completed Physical Hardware	8	Hardware has been assembled	Create a basic vision system for a camera inside the delivery section that responds to a package being placed inside the device and changes the

				touchscreen to allow delivery.

Design Tasks Breakdown (Table 4):

Task	Milestone	Hours	Dependencies	Description
Compile list of desired notifications and functionalities	Design App UI	2	None.	List all functionalities and notifications that relate to the actual product.
Create an app sitemap	Design App UI	3	Compile list of desired notifications and functionalities.	Map the pages of the app and how they connect.
Illustrate each app page	Design App UI	5	Create an app sitemap.	Create a storyboard with a drawing of each page.
Design visuals	Design App UI, Design Website UI	3	None.	Design menus, logos, product drawings, any other graphics to be used on both the app and the website.
Compile necessary information.	Design Website UI	2	None.	List all information that needs to be on the website.
Create a website sitemap	Design Website UI	3	Compile necessary information.	Map the pages of the website and how they connect.
Illustrate each web page	Design Website UI	5	Create a website sitemap.	Create a storyboard with a drawing of each page.
Sketch prototype	Design hardware model for review	2	None.	Illustrate the hardware components of our design, to send for review by the manufacturing team.

Risk Assessment (Table 5):

Risk	Probability (L,M,H)	Impact (L,M,H)	Effect on Project	Preventative Measures	Triggers & Contingencies
Equipment or any (Laptops, Presentation tool) malfunction during demos	M	H	Clients are less likely to understand the project without the demos	Backing up the presentation on several devices or cloud At least one other team member is made to practice the demo presentation to take over in case of malfunction	Trigger: Clients feedback during presentation Action: Designated team member takes over with their device and presentation
Delays in one aspect of project causing a stall in the other/others	M	H	There will be delays in delivery hence possible decrease in the quality of work delivered	Reduce inter-dependence of the work Giving components that depend on inter-team collaboration given higher priority	Trigger: The team that needs the component alerts the team supposed to deliver it Action: The component is prioritised and people with time from other teams are assigned to help out to deliver the component on time
Team-mate unable to complete their portion of work	M	H	The team affected will not be able to deliver their work on time which will t affect the whole team's performance	During the week when there is a deliverable to be presented there will be a minimum of 2 check-in meetings for a duration of 15 mins to check each other's progress	Trigger: A team-mate report's it or the person themselves report the issue Action: A team member adept at what the person is working on will try to assist and in the case that that is not sufficient a meeting with a subject expert will be set up for the next day. In the case that the report has been made too close to a deadline all team members will share the work equally and complete it to the best of their ability.

Last minute design changes	M	H	Loss of time due to prior work (research and requirements +design documents) being redone	Go over several iterations of design, build and test before the final deadline.	Trigger: Team unanimously decides on the need for a change in design Action: Preparation of new timeline reflective of the time constraints facing the project and strictly work within that time frame
Cost rise during the project	M	M	Either a request being sent out to the university for more funding, thus a delay till the response or a compromise in the quality of the prototype/product produced	Using cost effective products for the build of the prototype/product	Trigger: Team/member in need of the purchase/s alerts the member in charge of finances Action: Communications to university will be sent out Products with lesser quality are considered or the team will meet to decide on whether the component is needed at that stage
Inability to accurately capture user requirements	M	H	Will result in Hardware/Software that does not satisfy the user's needs or a delay if needs are realised in a later process and this ends in a change in design	Using tools such as user stories as well as research into the target market in capturing requirements	Trigger: Discovery of use cases that weren't previously considered Action: Depending on the time of discovery either cater for that use case or include a suggested solution in the use case
Poor intra- team communication	M	H	Possible delays as interdependent teams will not be able to plan appropriately for the delivery of priority components needed for another team/s	Regular and planned meeting schedules for checking in on progress at the end of the week against set milestones	Trigger: Team/member raises it as an issue Action: Meet to assess what the obstacles are in communication Re- assess the plan for the meetings and restructure given that it is the problem.
Selected design proves inadequate to solve the problem	L	M	User's will not be able to make the most out of the product User's will not express interest in the product Other problems arise due to the product	Thorough verification at each major stage of the project lifecycle	Trigger: Team/member identifies an inadequacy in the solution to solve the problem Action: Work on modifications in the design that could make it adequate Choose a design that is better suited to the time constraints and include anything that could have been improved with more time in the report
Identification of Negative Environmental or Social effects of the proposed solution	M	M	Deter user's from choosing the product by opting for a more Environmentally friendly or Socially better solution	Thorough research into the effects on the environment and human life of the automation of the activities the project aims to assist Make sure any products used are environmentally safe and minimise any negative social effects	Trigger: Team/member identifies a negative effect due to the project Action: In the case that it is a particular component that is problematic, research a more sustainable replacement or a component with a better effect on social life In the case that the effect stems from the design or requirement analysis stages, depending on the time it is discovered, either reassess the work and fix it or mention this problem in the later report and include possible solutions.

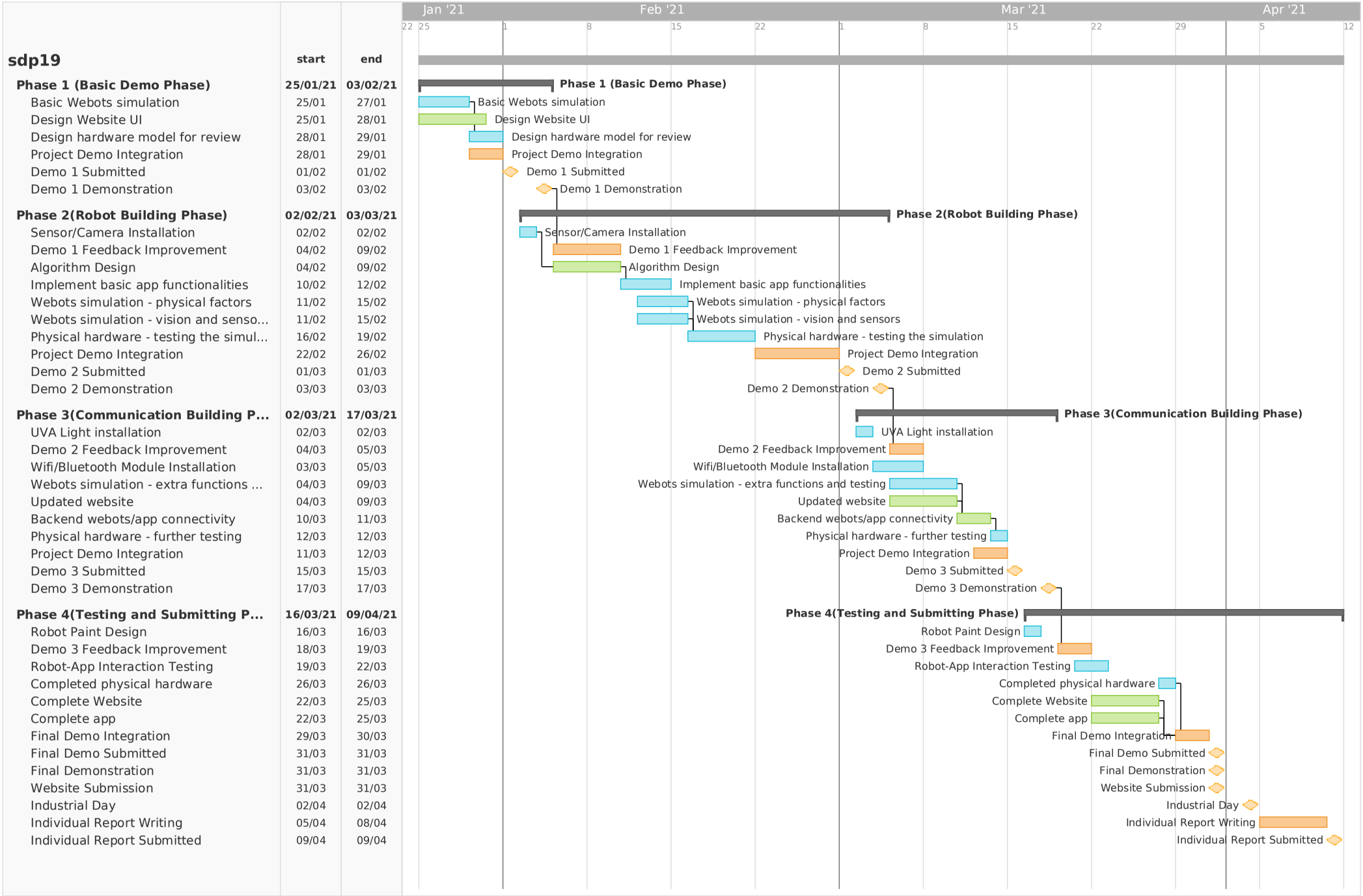
Time Allocation (Table 6):

Team Member	Research	Product Dev*	Workshops	Meetings	Demos	Reports	Final Presentation	Total
Chris	8.3	112.9	20	30	10	10	8.8	200
Harry	8.3	112.9	20	30	10	10	8.8	200
Neo	8.3	112.9	20	30	10	10	8.8	200

Huachang	8.3	112.9	20	30	10	10	8.8	200
Yizhuo	8.3	112.9	20	30	10	10	8.8	200
Amy	8.3	109.7	20	30	10	10	12	200
Hrichika	15	103	20	30	10	10	12	200
Hallelujah	15	103	20	30	10	10	12	200

Resource Allocation (Table 7):

Team Member	Software Dev	Webot Dev	Design	Equipment
Chris Perceval-Maxwell	Java, Android Java, WebDev	N/A	Photoshop, Figma, UML, DBMS schema design, CSS	N/A
Harry Lennox	Java, Python,Computer Vision	N/A	UML	Raspberry Pi
Neo Zhu	Webot, Arduino	Yes	UML	N/A
Huachang Song	Java, Python, Software - backend	N/A	UML, HTML, Adobe	Raspberry Pi
Yizhuo Yang	Java, Python, Software - backend	N/A	UML, HTML, Adobe	Raspberry Pi
Amy Rafferty	Java, WebDev, Python	N/A	UML, HTML/CSS	N/A
Hrichika Nag	Java, Software - backend, Python	Yes	UML	N/A
Hallelujah Kebebe	Java, WebDev, Python	N/A	UML, HTML/CSS	N/A



sdp19	start	end
Phase 1 (Basic Demo Phase)	**25/01/21**	**03/02/21**
Basic Webots simulation	25/01	27/01
Design Website UI	25/01	28/01
Design hardware model for review	28/01	29/01
Project Demo Integration	28/01	29/01
Demo 1 Submitted	01/02	01/02
Demo 1 Demonstration	03/02	03/02
Phase 2(Robot Building Phase)	**02/02/21**	**03/03/21**
Sensor/Camera Installation	02/02	02/02
Demo 1 Feedback Improvement	04/02	09/02
Algorithm Design	04/02	09/02
Implement basic app functionalities	10/02	12/02
Webots simulation - physical factors	11/02	15/02
Webots simulation - vision and senso...	11/02	15/02
Physical hardware - testing the simul...	16/02	19/02
Project Demo Integration	22/02	26/02
Demo 2 Submitted	01/03	01/03
Demo 2 Demonstration	03/03	03/03
Phase 3(Communication Building P...	**02/03/21**	**17/03/21**
UVA Light installation	02/03	02/03
Demo 2 Feedback Improvement	04/03	05/03
Wifi/Bluetooth Module Installation	03/03	05/03
Webots simulation - extra functions ...	04/03	09/03
Updated website	04/03	09/03
Backend webots/app connectivity	10/03	11/03
Physical hardware - further testing	12/03	12/03
Project Demo Integration	11/03	12/03
Demo 3 Submitted	15/03	15/03
Demo 3 Demonstration	17/03	17/03
Phase 4(Testing and Submitting P...	**16/03/21**	**09/04/21**
Robot Paint Design	16/03	16/03
Demo 3 Feedback Improvement	18/03	19/03
Robot-App Interaction Testing	19/03	22/03
Completed physical hardware	26/03	26/03
Complete Website	22/03	25/03
Complete app	22/03	25/03
Final Demo Integration	29/03	30/03
Final Demo Submitted	31/03	31/03
Final Demonstration	31/03	31/03
Website Submission	31/03	31/03
Industrial Day	02/04	02/04
Individual Report Writing	05/04	08/04
Individual Report Submitted	09/04	09/04

References

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