iRobot App Store: Business Proposal

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Abstract

Connected home market is set to grow to more than $58 billion business by 2020 and $200 billion market by 2025. iRobot has the unparalleled opportunity to leverage its experience and market share to connect robots with myriad of other devices of smart home. In this business proposal, we present a strategy for iRobot to expand its business into connected homes. We propose iRobot to launch an 'iRobot App Store' to allow customers to use iRobot in many possible ways by download different applications and by crowdsourcing the development by releasing the SDK to create and publish apps on 'iRobot App Store'. We propose to invest $12 million in the first year and $10 million each subsequent year and without any optimistic predictions we will achieve break even before the end of five years.

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Introduction

Homes of the future are going to transform the way we live. Smart and connected homes will merge seamlessly into the fabric of everyday life. Connected homes will not only able to do most of the mundane but important tasks for us like cleaning, cooking, gardening, but will also be self-adjusting to efficiently manage energy related resources. The notion that even our homes will serve as a natural extension of us seems futuristic but recent advancements in hardware miniaturization and cloud computing will drive this technology change quickly.

The connected home market is set to explode with more than 58 billion dollar [1] by 2020 and 200 billion dollar market by 2025 [2]. The efforts to connect homes has already started and big players like Cisco, Google (NEST), Apple, Microsoft, Qualcomm have invested heavily in it. At present, the concentrations are in creating sensors, smart devices, cloud platforms to connect security and machine learning to extract knowledge from big data. However, very little efforts are being made to integrate robots with connected homes.

In home robotics, iRobot has been the pioneer to successfully capture the cleaning robots markets. With 68% market share in this segment, iRobot has been phenomenal in creating the products by solving a lot of hard technical and non-technical challenges. The cleaning robot market is expected to reach 2.5 billion by 2020 [3] at the CAGR (compounded annual growth rate) of 15.6% and iRobot is set to continue to capture this market. Other than this linear growth, iRobot can disrupt the connected home robots market. The new Roomba 980, with cloud connectivity through Wi-Fi is the first step towards connected home where a user can clean the house with tap of the button. The technology platform already established by iRobot can be leveraged to capture the untapped potential of developing robots connected to smart homes.

The strategy to capture this market would be to create ‘iRobot App Store’. The App Store will enable the users to download apps for their needs and will allow them to use robots in multiple ways. It will also bring down the technology barrier from developers by providing them a SDK to leverage various perception, path planning and mapping software already developed by iRobot. The App Store will enable developers to discover some novel applications of robots at home and will allow connectivity with a myriad of other smart devices.

Market Analysis and Opportunity

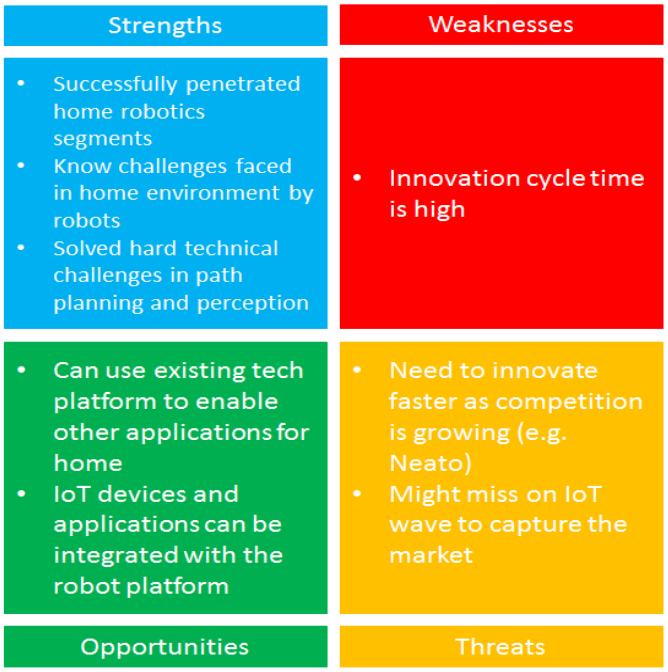

Figure 1: Strengths, Weaknesses, Opportunities, Threats Diagram

Figure 1 is the SWOT analysis of iRobot to see the strengths which enable this opportunity as well as weaknesses and threats which lie ahead.

iRobot has successfully penetrated home robotics market by selling 14 million Roombas. This large user base serves as a competitive advantage for iRobot and over time earned their trust. iRobot knows what are the hard challenges the robot faces in the environments at home and how these challenges can be mitigated. Figure 2 reflects the number of possible markets and the target market the App Store will pursue.

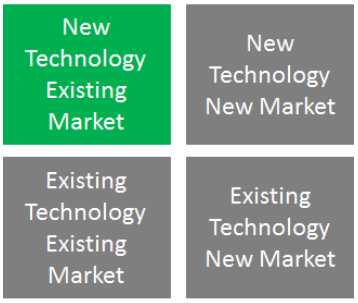

Figure 2: Target Market

iRobot weakness can be reflected from its 13.7-year long "innovation cycle time"[4]. Innovation cycle time is the process involving 4-D's: Define, Discover, Develop and Deploy. By creating the App Store, iRobot will be empowering developers to help keep current products relevant and useful.

Figure 3 shows the vision at iRobot taken from the presentation of the head of CEO strategic initiatives. It is in the sync with the vision that is laid out above and the goals of the App Store. With crowdsourcing the development in the form of 'App Store' this vision can be achieved earlier than traditional in-house product development.

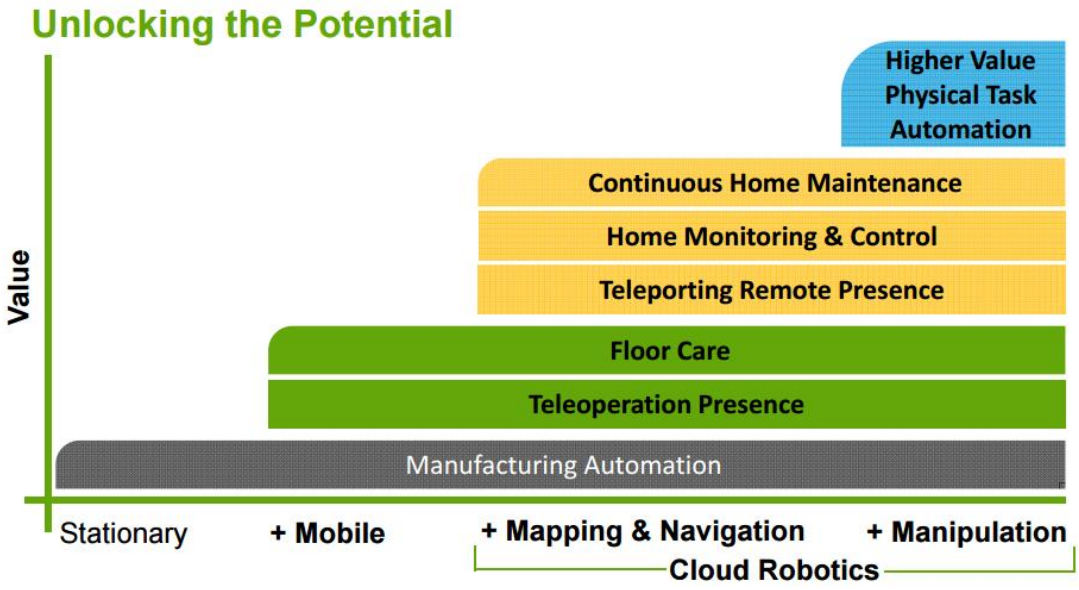

Figure 3: iRobot Vision

The iRobot App Store

The iRobot app store would engage the interest of app developers, iRobot, and consumers by enabling each group to focus on to do what they do best and mutually benefit each other.

Robotic application developers currently find it difficult to develop new robotic applications since there are significant barriers to entry in the field of robotics. Startup costs are high and absence of standardized platform stop many good inventions in their tracks. The Create 2 platform is a step towards providing a standardized development platform but it far too simplistic to be useful. Providing a robust SDK will encourage app developers to make their killer apps on iRobot platforms, bringing down these barriers to entry and freeing them to innovate. Once their

app is approved, they can showcase their idea to the entire iRobot customer base and earn money based on an appropriate funding models. Additionally, the developers can submit code to be used by others under a licensing infrastructure similar to the one in place in the mobile application development community.

iRobot has been the most successful consumer robotics company to date and has penetrated the robotic floor cleaning market, but this is only the beginning. iRobot's platforms could do so much more but it is difficult to justify the design a product in traditional product development around one specific niche use case. Connecting developers and customers through the App Store will allow users to get additional utility from their iRobot platform thus increasing the value of any iRobot product. iRobot will be able to capture additional revenue by taking a small commission from the sale of each application or through advertising revenue through the App Store.

Customers are showing increasing desire for robots in their homes. Making them customizable to their own preference is a huge incentive for customers to use these apps and also purchase additional hardware. They benefit because of the multiplicity provided by just one robot; for example, their Roomba can not only clean their floor on schedule but with the purchase of an app now patrol their home for intruders when away. This will result in iRobot being their one-stop shop for in home robotics.

Ideas for Seed Apps

The App Store will need to begin with a few applications developed by iRobot to engage users and developers. These seed apps serve two important purposes; They serve as tutorials and learning resources for developers while at the same time attracting iRobot customers to use the App Store for the first time. Several ideas for these seed apps are listed below:

1) Home monitoring and security: Once the user activates the alert mode on the Roomba, the robot will keep a close watch for suspicious movements by moving around the house like a security guard. The robot will pass through predefined position of special interest in rounds. For example, the user might have a safe in the bedroom, in which case the user will program that location as a waypoint in the Roomba's rounds. Depending on the significance of the location, the user can input weights on waypoints. The Roomba might

then spend more time at the more significant waypoints, keeping a closer eye. If the only possible entry is from the door then it will guard the door.

2) Monitoring baby-sitters: We all want to make sure whether our children are safe with the baby sitters. No need to install separate cameras anymore, Roomba can now be the supervisor.
3) Monitoring elderly: Roomba can follow the elderly at a safe distance and make sure that they are active and mobile. Since it moves on the floor, it can identify potential tripping hazards (uneven surfaces) and alert the elderly and their caretakers. It can also detect if a person has not shown any movement for an unreasonably long time. If a person has fallen on the floor and is not able to get up, the Roomba can call for assistance.
4) Finding lost items: People often lose/drop small pieces of jewelry, buttons, needles etc. on the floor, and it can be very difficult for them to locate it. Computer vision based object recognition techniques can be used to locate these objects and inform the user.
4) Visualize 3D image of home: Users may be interested in seeing what the Roomba is seeing. This app would allow the users to view the map of their home and show off their homes to friends and family in a new way. Figure XX shows a rough 2D map collected by the vSLAM algorithm.

Figure 4: vSLAM Generated Map

Technical Details

Minimum Requirements

In order to integrate a platform with the proposed App Store, a minimum set of specifications must be met to download apps to the device and run them. First, the robot must have an interface to send and receive data either through a direct internet connection such as Wi-Fi or ethernet cable or direct connection to a device such as a phone, computer, or tablet that has internet access. Second, the robot must be able to store new programs in memory or security updates and run them when disconnected from the App Store or connected device. Third, the computer needs to have enough computational power to run the app or be compatible with an external device that is capable of running the application. Applications that have these minimum requirements will be able to support the App Store with few modifications. App Store integration should be considered for future products on all iRobot consumer robots.

Platform Readiness

Platforms that have high potential for app-driven improvements are those with visual perception systems capable of SLAM or platforms with the capability to physically interact with the environment or users. The robotic platforms for the initial launch of the App Store will be limited to the Roomba 980 series and Create product lines [5]. These platforms require minimal changes to meet the baseline specifications for integration with the App Store and have high potential for improvements from the App Store.

The latest Roomba offerings are the 650, 770, 870, 880, and 980 series. The 980 series Roomba is the best candidate for its built-in Wi-Fi capabilities, preexisting app support, and vision system which are absent from the other models. Once the user establishes the Wi-Fi connection, the 980 Roomba will be able to download updates from iRobot or apps the user wants to use and may even access cloud-based services. The combination of visual sensing, ability to move in the home, and access the internet offer exciting and endless possibilities for new applications limited only by the imagination of the developers.

The Create 2 product is targeted for education, STEM outreach, and hobbyist audiences. A simple interface is offered to interact the motors and sensors of a refurbished model to an external computer or microcontroller. By adding app support to the Create 2, we make it easier for students and school to make interesting applications with relative ease, promote more widespread adoption of the Create 2, and get younger audiences familiar with iRobot systems and applications. The Create 2 will require several software and hardware changes to make the product ready for app store integration mainly including the addition of Wi-Fi, USB 2.0 ports, extended GPIO pins and more powerful computing. These change will be rolled into a new version called Create 3 which will be the first Create version to hit the App Store.

Technical enablement

To realize the benefits of the iRobot App Store, several key technical components must be developed to attract developers and customers alike. One of the startup challenges will be to incentivize developers to invest their time on developing new applications on the new App Store. As awareness and profitability of the iRobot App Store increases, the developer relationship will need to be maintained and services will need to scale with adoption. The top technical enablers for the Roomba are a repackaging of the core robotic features into a useful SDK, the creation of Developer Tools where developers can create and test apps for end users, development of

interfacing hardware to extend the base features of these platforms, and finally the assurance that any iRobot App will protect the privacy and personal information of the user.

To develop the SDK, iRobot will need to invest in the initial creation and commit to continual support of the tools. A key portion of the SDK will be the implementation of an application programming interface (API) that developers will use to access low level sensors and motors as well as high level features like path planning. Features like the proprietary vSLAM and iAdapt 2.0 Navigation features on the Roomba platform will be wrapped into this API with little difficulty. The API will also need to support sensor interfaces with the onboard vision sensor and other integrated sensors. The most difficult to task will be to design the SDK to support intuitive usage for core robotic features like path planning, mapping, and obstacle avoidance. Developers of all skill sets need to have control over these complicated features at different levels of abstraction. No matter their skill set, any developer should be able to do what they want to do. The design and implementation of a well-planned API to interface with iRobot platforms will be the core enabler to success of the iRobot App Store.

Developers will need capable tools to interact with the acquired map, perform feature extraction, manipulate the path planning algorithms, detect obstacles, and other core robotic features. These complex robotics features, supplied by the SDK, will require a sophisticated interface to test, debug, and verify their applications. Simulation tools will speed up time to market and serve as benchmark testing before public consumption. A wide range of tools are available today and can be licensed to enable some of these developer tools. An evaluation of commercially available tools and open source software like ROS or Gazebo[7] should be conducted and weighed against internal development of these tools to see which option is most appropriate.

To unlock the full potential of the robotic platforms, developers may need to extend the sensing capabilities of the platforms or add motors, servos, or other hardware to enable new applications. Currently the Roomba does not offer any electronic interface for developers to extend. For example, users may want to add a USB microphone to their application to enable voice commands or add a hobby servo to enable a camera to pan or tilt. A recommended baseline interface would be 2 USB 2.0 ports, 5 volts power source offering at least 500 mA, 6 analog inputs, and 6 general purpose input/outputs with Pulse Width Modulation capabilities. Other premium features to consider are USB 3.0, IEEE 1394, Bluetooth, and Wi-Fi support which can be offered as optional add on, retrofit, or added to the baseline model if the pull from developers is sufficiently

strong. The addition of these baseline and premium features will add cost the manufacture and sale of the Roomba and Create 2 platforms but will unlock the real technical potential of these robots, engage customers and developers with iRobot products, and offer big payoffs in the future.

Most importantly, the App Store will need to protect the security and privacy of the users from malicious developers and hackers trying to get access to personal data. The reputation of iRobot's consumer home robotics as safe and friendly must be upheld at all cost - the erosion of this reputation is a significant risk to iRobot and the whole field of consumer robotics. If public opinion should change to mistrust of iRobot or in-home robots, it will be a long time before trust can be reestablished. Should this happen, it would no doubt set the industry back years. To ensure the security of the user full encryption should be standard, all new apps need to be screen to ensure no personal data is recovered by the developer, and the user needs to be in control of the extend their data is used to improve their services and apps.

Implementation Plan

To implement the iRobot App Store, The technical enablement conditions need to be met and a marketing campaign will be launched to generate customer and developer awareness. To meet the technical enablement for the Roomba 980 and Create 2 platforms, teams must be formed to create the SDK and Developer Tools as well as support the continuous development and patch any security gaps that may arise for at least the next 5 years. Changes to the Create 2 and Roomba 980 need to be handled by the platform teams responsible for the development and support of these products. Current plans require one year of development and 12 million USD in initial startup cost and commitment for 10 million USD in operating cost through 2020.

To attract the first round of early developers, the developer relations team will employ a multi-concerted effort to incentivize and retain key developers. iRobot will provide free training to early developers to demonstrate the quality of the SDK and Developer Tools to get early feedback to improve the developer experience. Additionally, iRobot will waive the cost for the first applications released through the App Store and hold early promotional awards for early developers. Rough figures put the cost of early developer programs at approximately 2 million.

In the first year, iRobot marketers will generate and disseminate marketing literature aimed at customers to generate awareness and add realized product value. The target audience will be tech-savvy, busy adults in the mid to upper class - the core segment of iRobot products. The

marketing team will also design and implement a customer promotional program to offer incentives to the Roomba for new purchases as well as pre-existing customers. It is estimated cost of the marketing program will cost approximately 3 million during the first year.

To build the SDK, an estimated 50 developers will be needed to generate the first SDK and Developer Tools in the first year. After initial development, an estimated 15 people will be required to support the SDK and 6 to monitor and improve the Developer Tools. Additional support may be required according to pull from developers and customers.

Long term support of the customer and developers will be critical to the success of the App Store. The customer marketing and developer relations programs will operate on 3 million USD per year for the first 5 years. The SDK and Developer Tools teams is expected to operate on 7 million USD per year on this time span, resulting in a combined total operating cost of 10 million USD for the App Store.

Business Projections

Revenue model

Revenue will be generated either by a charging fee for each app purchase or by advertisement sales. As part of the Customer promotional program, any seed app will be available for free and third party apps will be free for the first 6 months. Thereafter the customers will have to pay a fee of $2 to $7 based on the criticality of the app or depend on an advertisement revenue and not charge users an initial fee. For example, for a novelty 3rd party app may offer the application for fee but occasionally display ads on the user interface. For a 3rd party home monitoring application, the user may have to pay a one-time fee of $5 which is more appropriate than showing advertisements to prevent the appearance of mishandling user data.

Moreover, with each new Roomba unit sold the user will get free access to all apps for first 3 months after which advertisements will be begin or the user will be prompted for a one-time fee.

Table 1: Financial Projections

Year	2015	2016	2017	2018	2019	2020
Home robot sales in units (million nos.)	1.0	1.2	1.4	1.7	2.1	2.5
Roomba 980 sales in units (million nos.)	0.1	0.2	0.3	0.4	0.6	0.9
Revenue thru Apps/unit (in $)	0.0	0.0	25.0	25.0	25.0	25.0
Annual revenue (in million $)	0.0	0.0	7.2	10.8	15.6	21.8
Annual Investments (in million $)	-	12	10	10	10	10
TOTAL Annual revenue up to year (in million $)	0.0	0.0	7.2	18	33.6	55.3
TOTAL Investments up to year (in million $)	-	12	22	32	42	52

The annual profit in the year 2014 earned for home robots segment of our products was approximately $250 million [6]. There were approximately 1 million iRobot home robots sold in 2014. Out of these 1 million, 10% are the Roomba 980 model with all the Wi-Fi and vision capability. Since 2012, the number of robots sold has increased by 19% as outlined in Table 1. This growth rate is expected to increase to at least 25% for the next five years. At the same time, the percentage of total sales of the Roomba 980 as total number of home robots is expected to increase by 5% year over years in response to the App Store. Therefore, the returns would begin only from the second year of the launch. Based on these estimates, if each user generates at least $25 in advertising or direct sales revenue, the business would reach break-even in 5 years, as shown in figure 4. The initial investments are estimated at $12 million for the first year and anticipated to cost $10 million per year for the next 5 years. This investment is 4% of our current annual profit of $250 million, which is on par with iRobot R&D spending.

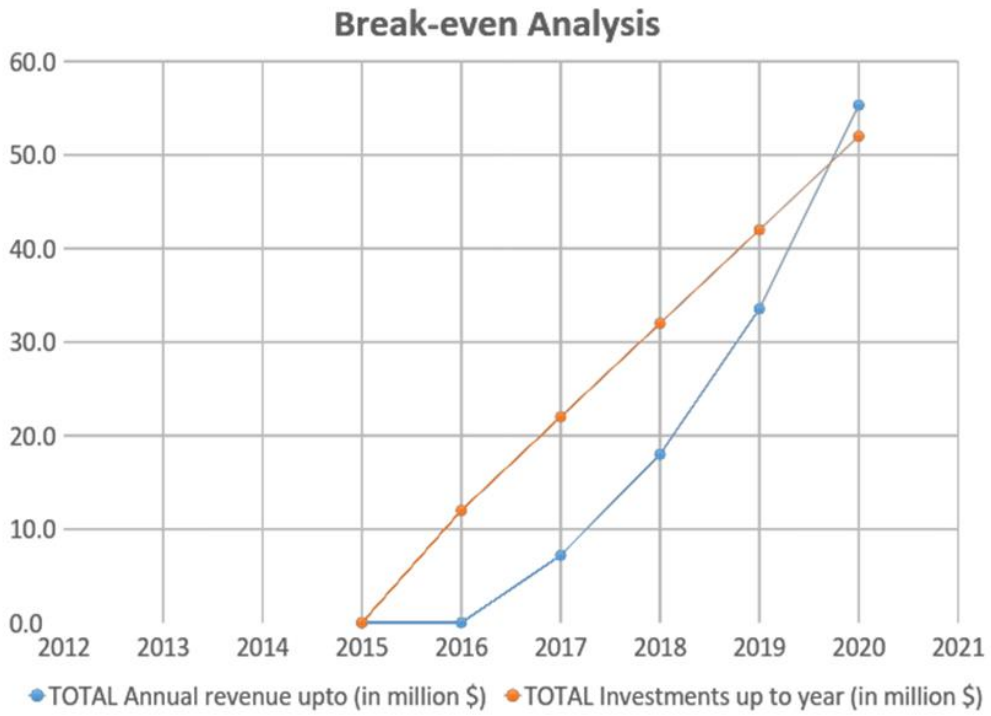

Figure 5: Revenue and Cost

Benefits

The business projects, there is a huge potential for financial growth if we create the App Store. iRobot will be the pioneer in the home robotics space and have the power to shape market trends and profit from the growth of the market place. The app markets for smartphones demonstrate this huge growth possibility.

Application developers can showcase their idea to the entire iRobot customer base and earn money based on an appropriate funding models. Additionally, the developers can submit code to be used by others under a licensing infrastructure similar to the one in place in the mobile application development community.

iRobot will allow users to realize additional utility from their iRobot platform thus increasing the value of any iRobot product. iRobot will be able to capture additional revenue by taking a small commission from the sale of each application or through advertising revenue through the App Store.

Customers benefit because of the multiplicity provided by just one robot; for example, their Roomba can not only clean their floor on schedule but with the purchase of an app now patrol their

home for intruders when away. This will result in iRobot being their one-stop shop for in home robotics.

A smart connected home is forecast to be a $200+ billion market by the year 2025 [2]. iRobot is moving forward towards providing devices which can interact with each other to seamlessly deliver the consumer's smart home preferences. Our key competence is to develop the map of the house which can be used to for applications which require spatial context such as (a) light occupied spaces (b) accent lighting in adjacent spaces (c) close nearby AC vents if windows open etc. Developing an App Store would be a significant step towards these goals since this demonstrates the capability of Roomba to perform other tasks apart from cleaning the house. It also helps in building a network of developers which can be extended to developing apps for smart homes. In addition, it increases the market penetration which gives us a competitive advantage over the other players.

Figure 6: Integration of Roomba with Smart Homes

Challenges and Risks

There are 3 main identified risks of the iRobot App Store. The first risk is not getting enough early customer or developers adopters. This could happen because the SDK was implemented poorly and resulted in a bad experience for developers. If the developers do not innovate new apps then there is no chance of attracting the customer base needed to make this idea successful. And if there is not a sufficiently large consumer base, developers will not be motivated to create apps for

a small audience. To ensure this does 'chicken and egg' scenario, this risk is being mitigated by ensuring sufficient resources are being devoted to the SDK development. To attract the customers and developers, developer promotional and customer promotional programs will be launched at approximately 5 million.

The last identified risk is the chance that a consumer robotic competitor will go to market with a similar App Store and gain market share. This risk is unlikely to come to reality since iRobot is the only company with the sales volumes and customer base to support such a program. Competition would more likely come from a home automation company like Nest, but would likely be more symbiotic in nature than competitive.

Conclusion

The Roomba vacuum cleaner has good acceptance from the home users. To increase market presence, iRobot needs to demonstrate additional applications of the hardware platforms. By creating iRobot App Store, customers will be empowered to explore the possible capabilities of our platforms. It will also enable the developers to create apps faster by abstracting the hardware and the complex algorithms of path planning and perception and focusing on the killer application.

The business plan proposes the development of the app store in several states. First, iRobot will launch 'Seed Apps' for existing Roomba 980 model without any hardware modifications and open this platform up to developers. Next, the Roomba 1000 and Create V3 will be rolled out with hardware and electrical modifications to unlock more possibilities of new applications.

Due to additional applications, it is forecasted the sales of advanced models of Roomba would increase to nine times of the current sales. Our increasing presence in the robotic home market would help us reach our goal of dominating the smart homes market. By combining the innovation of developers with iRobot applications through the App Store, iRobot is positioned well to dominate the home robotics field for years to come.

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