Abstract Section

Honey bees are dying and we want to help them. The problem is **Colony Collapse Disorder.** It kills 40% of honey bees every year in the USA. Bees pollinate 70% of the world's crops that feed 90% of the world.

We will create the **Ai Medic Bee** to save the bees. It is an artificially intelligent bee full of advanced technology that is placed in a hive to monitor the activity of the bees. It looks and acts like a bee and can communicate with bees in the hive. It can detect any problems in a bee colony and will inject medicine into sick bees.

Ai Medic Bee is ready to respond to and cure bee health problems. It is a tiny ambulance sitting inside a hive. It will be affordable and available for all beekeepers. **Ai Medic Bee** will save the bees and preserve the world's food supply.

Present Technology

Colony collapse disorder kills 40% of honey bees every year in the USA and researchers have been studying how to save them. Many scientists are trying to figure out ways to kill the mites and some countries are banning pesticides that may hurt bees. Lots of technology is being developed but none is designed to work as an ambulance. Here are some of the technologies that are being developed to help bees.

The Bee Health Guru is a smartphone app developed in Montana. By placing the smartphone in the hive entrance, it listens to the bees and sends information about the bees to the beekeeper. The limit of this technology is that it's not a real bee and it works only to diagnose rather than cure them. The Solution Bee offers a smart bee hive monitoring system that gives us information about how the bees are. It weighs the hives and checks the temperature to predict if everything is ok. Again, this technology has the limit of just sending information rather than taking action to solve the problems. The Hitachi tracking microchip can also track where sick and healthy bees are and locate good areas of wildflowers. The Robo Bee developed by Harvard Wyss Institute and the Robo Fly developed by University of Washington are robotics insects supported by micro electric motor. They are also experimenting on different types of motors that can fit the size of an insect. The problem is that doesn't look like or move like a real bee, which we believe it's a problem since it doesn't blend in (Figure 1). The bee sensor backpack developed by the University of Washington is a tiny backpack sensor that sits on the bee's back and detects their movements to learn more about their behaviour (Figure 2, which is a real bee). They have done this because the power source for the robot insects is not strong enough. The problem is that the scientists cannot control the bee.

Figure 1: RoboFly

Figure 2: Bee sensor

History

AI Computers:

AI was first thought about in the Ancient Greek times. Then people had an idea in 1956 to make AI but it was too expensive because they had yet to make more advanced computers. Computers would take commands but wouldn't remember them. Then in the 1980s, 'deep learning' techniques were added to computers to learn using experience which is what they couldn't do back in the 1950s. In 1997, a computer beat the world champion chess player Gary Kasparov in a game of chess. In the same year Voice Recognition was developed. Computers are expected to double their capability every 2 years which is known as Moore's Law. Now AI is used everywhere.

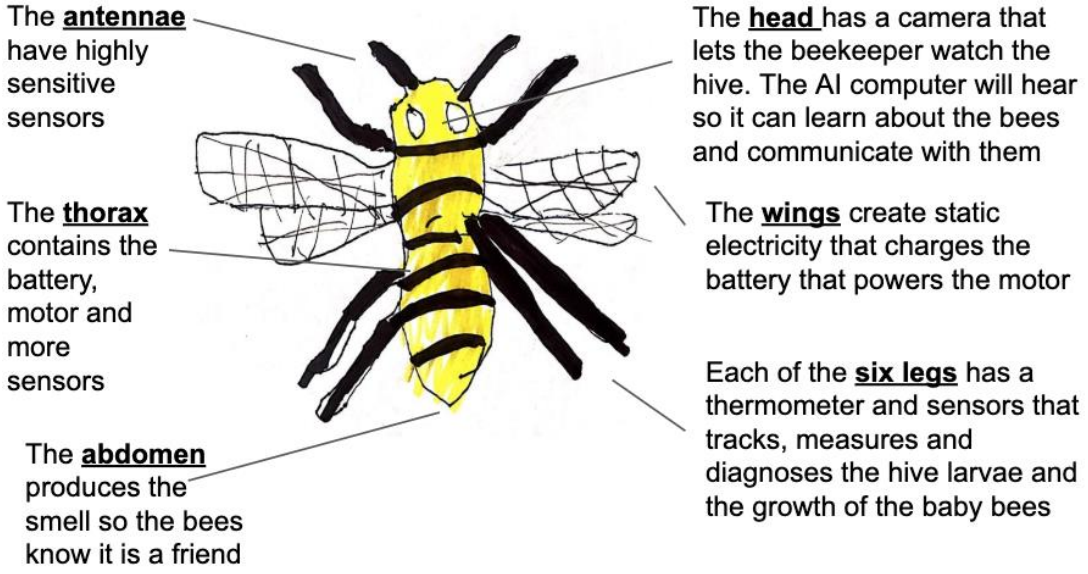
History of Robotics:

Robots are mentioned in Ancient Greece and China. In the Renaissance Leonardo da Vinci made the first known robot. Then in the 20th Century robot tech moved forward. They were made of hydraulics like the robots arms in car factories. They didn't have much movement. In 1974 a new robot arm was made and could bend all the way and had a programming computer which made it easier to program. Robots could only see in black and white which meant they would have difficulty performing simple tasks like picking up things. Then in the 1980s robots became able to see better and could be used for more tasks. Robots have been big and they do not look or act like humans. Most advanced robots have been research tools and you can't buy them. Robots became smaller and smaller with nano-technology. Powering these robots is difficult because the batteries are not strong enough.

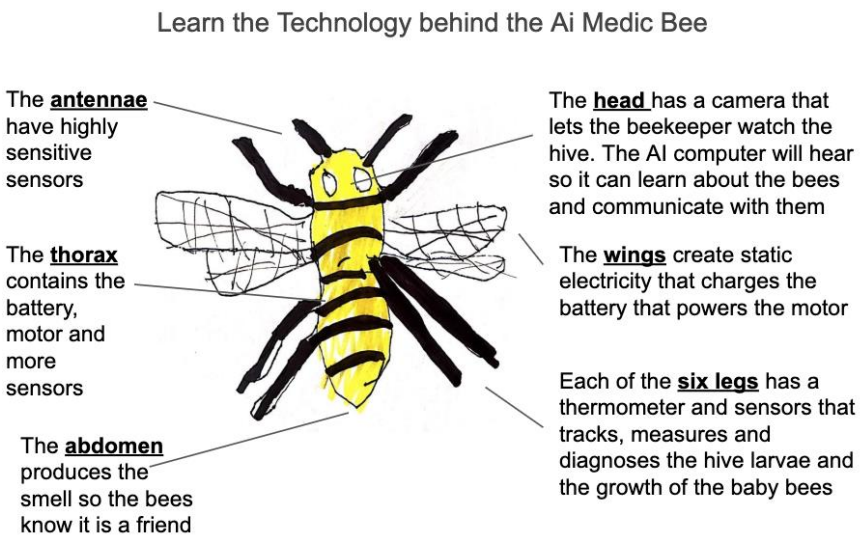
Future Technology – Slide 1

Ai Medic Bee lives in the hive and has the ability to monitor the health of the bees, diagnose illnesses and give sick bees medicine to keep them alive.

We will use technology and artificial intelligence to be able to make our bee small enough and powerful enough to be able to perform all its tasks. We will need materials and technologies to be tiny and smart to make up the bees entire body.



Future Technology – Slide 2



The **Ai Medic Bee** has a specialized function to tackle the problems in a hive.

- The Head has a camera that lets the beekeeper watch the hive. The head will have a powerful AI computer that will monitor the hive and work out what medicines to give sick bees.
- The Antennae have highly sensitive sensors so the AI computer can detect what is going on in the hive.
- The Wings create static electricity that charges the battery and powers the motor. The wing will also get the static electricity from the bees in the hive. The wings need to be strong enough to not break.
- The Abdomen copies the wiggle movements to talk to the other bees and houses the antidotes for the different illnesses that harm the bees.There is also a Stinger in the abdomen which acts like a syringe and injects sick bees with the antidotes.
- The Thorax contains the battery, motor and more sensors. The motor will be powered by a small battery that can be charged by static electricity.
- The 6 Legs each have a thermometer that tracks, measures and diagnoses the hive larvae and the growth of baby bees.

Future Technology – Slide 3

Each **AI Medic Bee** is able to check the health of the Queen, worker and drone bees. It can detect mites in larvae and parasites attached to the coats of bees entering the hives. It detects changes in temperature and seasons. It can sense if there are pesticides and insecticides in the environment and warn beekeepers. It monitors swarm activity and alerts beekeepers of early signs of colony collapse. The **Ai Medic bee** will collect data and share that information with the beekeeper community with an App. It helps bees to locate wildflowers for pollen collection.

When the **Ai Medic bee** finds sick bees, it will diagnose the problem. The AI computer will figure out what medicine to give. If it does recognize the illness, it will connect with the other **Ai Medic Bees** in the world to see if they have a cure. If there is no cure, it will take the bee out of the colony and notify scientists so they can figure out the problem. The **AI Medic bee** will have a stinger that will be like an injection to give sick bees medicine so they get better. The bee will be able to make medicine in their body.

Ai Medic Bee is designed to look like a bee and will make the same smell as other bees so that the other bees in the hive don't get spooked. It will learn the bee dances so it can communicate with the bees in the hive. One of the most important needs for this **Ai Medic Bee** is that someone is able to make it affordable for beekeepers to use. One challenge of our AI bee design is that it will be very expensive to manufacture because there are a lot of high cost parts, like the motor. We will need to make lots of bees to make them affordable. If it's too expensive it won't be used and the bees won't be saved.

Breakthroughs - Slide 1

There are four key technology breakthroughs to make the **Ai Medic Bee** to work today.

Tiny AI computer to act like a bee: We will use technology and artificial intelligence to be able to make our bee small enough and powerful enough to be able to perform all of its tasks. Ai Medic Bee has the ability to diagnose illnesses, collect data and share that information with the beekeeper. The computer needs to make a smell and learn the bee dances to look like a normal bee in the hive. Bees are social and they talk by movements and dances like the most famous one called the wiggle.The Ai computer will need to learn all these movements and dances. Bees make a smell called a pheromone so the guard bees know that they are not intruders. The Ai computer will need to produce this smell.

Detection sensors and medicine**:** The legs of the **Ai Medic Bee** require very delicate sensors and thermometers to measure and detect the health of the larva and bees.The Bee Health Guru app can track the sounds of the bees to make sure it's ok or not. The AI computer will have recipes of all the medicines and antidotes to save the bee and the **Ai Medic bee** will be able to make them in its body. It also has a tiny stinger to give sick bees medicine and cure them.

Breakthroughs - Slide 2

Robotics the size and shape of a bee: The **Ai Medic Bee** will need a motor and battery in the Thorax section of the body that is tiny enough and powerful enough to power all the functions of the robot. We will need nanotechnology to make the existing robotics small enough to be the size of a bee and also to be flexible and strong enough to move like a bee.

Power by converting static electricity: Bee wings create static electricity that are used to charge the battery and power the motor. **AI Medic Bee** will need to change static electricity to make it work for batteries. Right now static electricity is the wrong type.

We will test the **Ai Medic Bee** with a controlled experiment. We will have two hives next to each other and put an **Ai Medic Bee** in one. The two hives have to be next to each other everything the same. This includes environment, food and flowers, water, temperature, predators and the same type of hive bees. We will repeat this across many hives across the country. We expect that the colony with **Ai Medic bees** will not have CCD and we would see more honey and more bees in the hive.

Breakthroughs - Slide 3

N/A

Design Process – Slide 1

Step 1 - the idea: We saw a TV program about bees and learned about the problem with colony collapse disorder and how it might impact humans. We thought of three things to save bees. The first was an artificial bee hive. But we did not like the idea because bees may not want to live in it. Also, it would not save the bees if they are not in the beehive. Another idea was to invent special medicine but we did not like the idea because we don't know how to give the medicine to the bees. We chose the **AI Medic Bee** because it can be with bees all the time and give them medicine.

Step 2 - AI Computer: we thought the bee could be controlled by a human. But the problem is that humans cannot control the AI bee to look like a bee. We learned at our visit to University of Washington that small robots move too quickly to be controlled by humans. Also, there are many reasons for CCD and so the computer needs to be intelligent. We changed the design to have an AI computer so the bee works by itself. The AI computer can learn about new diseases and work out how to fix them.

Design Process – Slide 2

Step 3 - Using robotics: We discovered scientists are trying to make small robots but the current insects are too big and do not look like bees. We visited the Autonomous Insect Lab at the University of Washington and the researchers gave us advice on our design. We learned that bees have many muscles so the robot needs to be able to make the same muscles so it can look like a bee. We learned that we need to make the body strong enough to survive in the hive.

Step 4 - Source of power: The AI Bee needs a very small battery. At first, we wanted to have a charging station. The problem was where to put the station in the hive. Also the battery would need to charge a lot so the bee would need to go back and forth a lot. The second thing we thought of using solar panels. The problem is that there is very little sunlight in a beehive. We then thought of using wireless charging. The problem is the AI Bee might go out of range. Also the electricity might annoy the bees. We decided to use static electricity which is generated by the wings of bees. We like this idea as it means the hive does not need to be near electricity or power.

Step 5: Looking like a bee: We learned that bees are social and talk to each other with movement and also make smells so they do not look like an intruder. We changed the design of the AI computer so it can learn how to communicate with bees.

Design Process – Slide 3

N/A

Consequences - Slide 1

A positive thing for society is that there will be less sick bees and less colony collapse disorder. This means there are more and healthier bees. This will help with food production for humans. The technology and software in the **Ai Medic Bee** can be changed so it can work on humans. It can be in hospitals to look after patients and even give them medicine. When a natural disaster happens, the **Ai Medic Bee** can go and find injured people and tell the rescue workers where they are.

The negative consequence of **Ai Medic bees** is that it can change the environment. The **Ai Medic bee** might kill parasites and mites and this might impact crops in a way we do not expect. Also we might impact the environment because we will use lots of materials and metal to make the bees.

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Bee pheromones

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Other sources:

Visit to the Autonomous Insect Robotics Lab of University of Washington (Photos in Figure 1 and Figure 2).

Interview PhD students: Johannes James, Yogesh Chukewad, and Vikram Iyer

Ai Medic Bee

If you click on sources all the sources show up.

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Ai Medic Bee is ready to respond to and cure bee health problems. It is a tiny ambulance sitting inside a hive. It will be affordable and available for all beekeepers. **Ai Medic Bee** will save the bees and preserve the world's food supply.

Team Video

This is where we will have our video

Ai Medic Bee

Description of Present Technology or Problem

Honey bees are dying and it impacts the world's food sources.

Since the bees are at risk, researchers have been studying how to save them.

What's available today

The Robo Bee developed by Harvard Wyss Institute and the Robo Fly developed by University of Washington are robotics insects supported by micro electric motor.

The Hitachi tracking microchip can also track where sick and healthy bees are and locate good areas of wildflowers.

Solution Bee Hive System It weighs the hives and checks the temperature to predict if everything is ok.

The bee sensor backpack is a tiny backpack sensor that sits on the bee's back and detects their movements to learn more about their behaviour

Limitations of today's technology

Some technology has been developed but none is designed to work as an ambulance. A bee robot exists but doesn't blend with nature. Natural bees have features that allow them to communicate with other bees and present technology does not support communication with bees.

This page features a video of our vision. If the buttons under "What's available today" is clicked, a pop up will appear and explain the topic and its limitation. The arrows will allow you to scroll to all the additional technologies that exist today.

Ai Medic Bee

Learn How it Works

Learn the Technology behind the Ai Medic Bee

Description:
The Ai Medic Bee will give sick bees medicines.

It has a computer to learn about the bees and communicate with them. It will figure out the right medicine for them.

It will be powered by a battery that runs on static electricity it gets from the other bees and it's wings.

It needs to make sure it gives off the right smells so it does not look like an intruder

The **antennae** have highly sensitive sensors

The **thorax** contains the battery, motor and more sensors

The **abdomen** produces the smell so the bees know it is a friend

The **head** has a camera that lets the beekeeper watch the hive. The AI computer will hear so it can learn about the bees and communicate with them

The **wings** create static electricity that charges the battery that powers the motor

Each of the **six legs** has a thermometer and sensors that tracks, measures and diagnoses the hive larvae and the growth of the baby bees

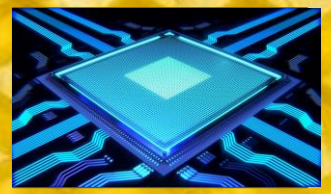
Key technologies

- AI computer to act like a bee
- Sensors and medicine
- Robotics the size and shape of a bee
- Convert static electricity for battery

How this page works: If you click on any of the key technologies it will show what they are. See next slide for description

Ai Medic Bee

AI computer to act like a bee



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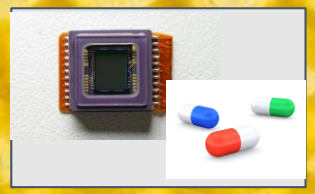
Sensors and medicine



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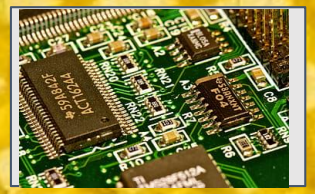
Robotics the size and shape of a bee



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We will need nanotechnology to make the existing robotics small enough to be the size of a bee and also to be flexible and strong enough to move like a bee.

Power by converting static electricity

Bee wings create static electricity that be used to charge the battery and powers the motor.

AI Medic Bee will need to change static electricity to make it work for batteries. Right now static electricity is the wrong type

Clicking on the pictures will give more detail of the technology

Ai Medic Bee

We watched a TV program that shows bees are important to the make food for humans but are dying because of Colony Collapse Disorder.

We wanted to design something that could save the bees and chose We chose the AI Bee because it can be with bees all the time and give them medicine.

We thought the bee could be controlled by a human. But the problem is that humans cannot control the AI bee to look like a bee. We learnt at our visit to University of Washington that small robots move too quickly to be controlled by humans. Also, there are many reasons for CCD and so the computer needs to be intelligent. We changed the design to have an AI computer so the bee works by itself. The AI computer can learn about new diseases and work out how to fix them.

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We learnt that bees are social and talk to each other with movement and also make smells so they do not look like an intruder. We changed the design of the AI computer so it can learn how to communicate with bees.

Final design!

When a circle on the timeline is clicked, the attached text and/or photo will enlarge. To exit back to this page, click the “x” on the corner of the text. Also the video the visit to the Autonomous Insect Lab will be included